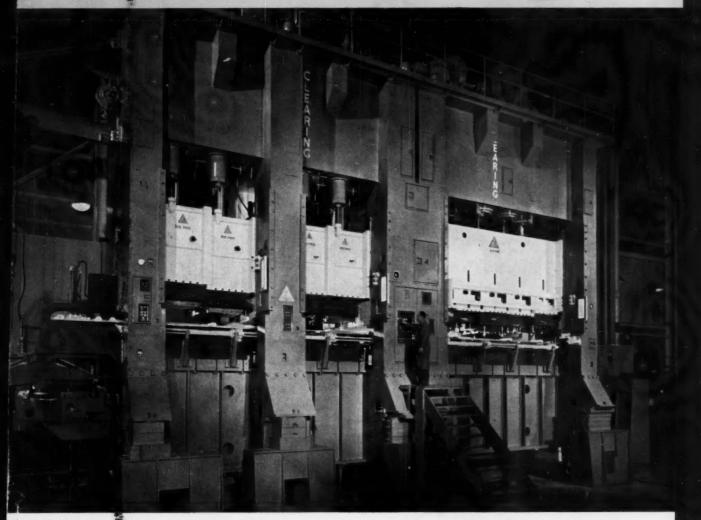
17th AIRCRAFT PRODUCTION NUMBER-JULY, 1957

Machinery



The future of press automation...HERE TODAY!

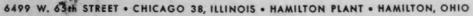
We call it a Transflex Modular press at Clearing. Transflex means the feed is designed to be readily adjustable to take on parts of varying dimensions and shape. *Modular* means that the press is built on the building block principle. If future requirements change radically, the press can be reassembled along completely different lines—even split up and run as separate units—to provide for these changes. So here

is press automation with a long range future. For all practical purposes, obsolescence proof—that's what we mean by the future of press automation.

A fantastic development? Yes. But this is only one of the many ideas you can find at Clearing for more efficient production of small and large parts. Just ask us about them. We have a lot of things to talk about and a wealth of material to send you.

CLEARING PRESSES THE WAY TO EFFICIENT MASS PRODUCTION

CLEARING MACHINE CORPORATION . division of U. S. INDUSTRIES, INC.





GUN DRILLING on a Bore-Matic gives

SURE-FIRE PRODUCTION

with

higher precision

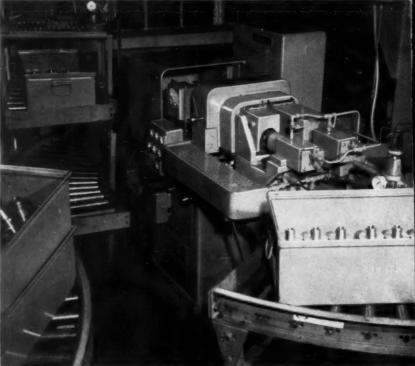
better finish

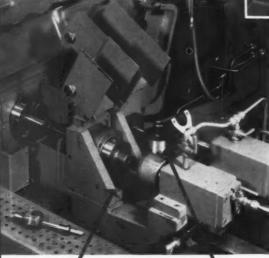
easier operation

less maintenance

lower costs

Model 121 Bore-Matic equipped for gun drilling is positioned in a conveyorized production line. Left foreground conveyor brings work to operator and lower background conveyor takes it to intermediate operations. Right foreground conveyor returns work for second gun drilling and upper background conveyor takes pieces away.





FRONT STATION—Gun drill plunger hole from solid. Coolant is confined inside part, after drill breaks through, by Neoprene tip on hydraulic clamping head. REAR STATION—Gun drill port hole from solid. Holes are plugged to confine pressure (750 psi) coolant inside work after drill breaks through. THE PRECISION and speed of a Bore-Matic make it a natural for gun drilling. For example, the two-station Model 121 shown here was fitted with adapters to hold the gun drills on the boringhead spindles and with hydraulic clamping heads mounted on the table for the mating bushings. It replaced a two-spindle gun drilling machine for handling the plunger and port holes in Nitralloy hydraulic heads. Here are the results:

PRODUCTION was increased from 24 to 27 parts per hour for plunger hole. Port hole production — previously done on drill press with final location by subsequent grinding of shoulder — went up to 48 parts per hour with accurate location.

TOLERANCES were reduced from .002 to .001. Both holes straight within 20 to 30 millionths.

FINISH was improved from 60 rms to 15 rms; and honing was eliminated.

OPERATIONAL handling time was cut in half.

MAINTENANCE was substantially reduced.

COSTS were cut by 75% over previous method.

Another plus factor was that the closer tolerances resulted in great savings in subsequent operations.

For more information on this and other interesting and profitable set-up possibilities with a Bore-Matic, get in touch with your nearest Heald representative.

IT PAYS TO COME TO HEALD!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York



MACHINERY

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Machinery

VOLUME 63

JULY 1957

NUMBER 11

SHOP PRACTICE

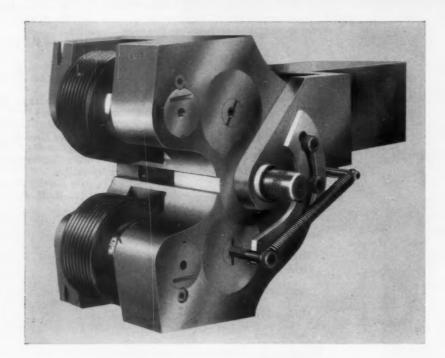
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Coarse Pitch Threads Rolled to Class 4 Fit..



The LANROLL Thread Rolling Attachments offer features designed to ensure greater accuracy, flexibility and economy when producing threads. . . . 4. RAPID AND PRECISE SET-UPS are possible

- PERFECT HELIX AGREEMENT allows rolling coarse pitch threads to Class 4 tolerances with long roll life. Threads can also be rolled directly to a shoulder with safety.
- ADJUSTABLE DESIGN provides wide range coverage for each attachment size without loss of rigidity.
- SUITABLE SIZES of LANROLL Attachments have been designed for all types and sizes of automatic screw machines and turret lathes with power feed.
- RAPID AND PRECISE SET-UPS are possible with special gaging methods designed for easy use and the elimination of "cut-and-try" set-ups.
- 5. Five sizes of Attachments roll a wide range of threads:
 #14—#5 to %"; #18—#5 to ½"; #20—%" to 1"
 #22—%" to 1¼"; #24—¾" to 1¾"

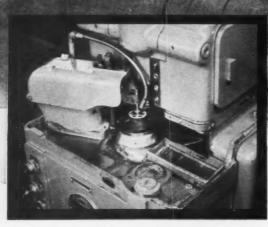
Other outstanding advantages of these LANROLL Attachments include: behind-the-shoulder threading; taper correction; and excellent thread finish and microstructure. For additional information ask for Bulletin G-96—please send specifications when writing.

LANDIS Machine COMPANY

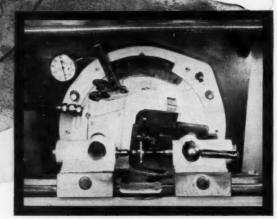
423-c



Puting the Finger" on supersonic demands



Fellows 3" Fine Pitch Gear Shaper cutting precision spur gears at Hughes Aircraft. Cutter speeds as high as 2000 strokes per minute are used.



Fellows No. 4 Fine-Pitch Gear Shaver finishes Hughes gears to tolerances as close as 0.0003" tooth-to-tooth composite error, 0.0005" total composite error.

THE PRECISION LINE





PRECISION GEARS...







M odern military aircraft travel 0.2 or more miles per second, missiles even faster! Control systems for detection and interception at such speeds must meet unprecedented demands for accuracy.

For their advanced armament control systems the "electronic brains" of all types of Air Force interceptor airplanes, both American and Canadian, now guarding the North American conti-

Fellows No. 4 Fine Pitch Red Liner records tooth-totooth and total composite errors on permanent graph for Hughes production control.

nent from attack—as well as for use in the Falcon air-to-air guided missile, Hughes Aircraft Company manufactures up to 15,000 precision fine pitch gears per month. Tolerances are as close as 0.0005" total composite error, tooth-to-tooth composite error not in excess of 0.0003". Yet standard Fellows Gear Production and Inspection Equipment does the job.

In use at Hughes are Fellows 3" Fine Pitch Gear Shapers and Fellows No. 4 Gear Shavers for production. Inspection instruments are Fellows No. 4 Fine-Pitch Red Liner instruments and No. 12M Involute Measuring instruments.

To combine extreme accuracy with high production rates, look to the complete line of Fellows gear production equipment. Write, wire, or phone your Fellows Representative at any Fellows Office.

THE FELLOWS GEAR SHAPER COMPANY 78 River Street, Springfield, Vermont

Branch Offices: 1048 N. Woodward Ave., Royal Oak, Mich. 5835 West North Avenue, Chicago 39 150 West Pleasant Avenue, Maywood, N. J. 6214 West Manchester Ave., Los Angeles 45

FELLOWS Gear Production Equipment

The Finest Machine Tools for Aircraft Plants ARE BUILT BY CINCINNATI MILLING



Die cavities in 100-ton die blocks for aircraft forgings are automatically tracer milled on this CINCINNATI Traveling Column Hydro-Tel Milling Machine. Equipment includes two independent cutting heads for machining the upper and lower halves of a die set simultaneously. Capacity: maximum size of die block, 12 feet x 30 feet, weight up to 100 tons. Vertical range of each spindle, 10 feet; longitudinal range of machine, 28 feet. Tomorrow's sleek new aircraft depend upon advanced thinking and engineering for machine tools today. These ingredients of progress are a Cincinnati Milling heritage. And they are evident in many CINCINNATIS now operating at peak performance in aircraft plants throughout the country. Cincinnati Milling has the engineering personnel, experience and facilities to build additional machine tools like them, or others completely different... operator controlled or automated to any degree desired.

Two large cincinnati® Milling Machines, built to specifications for prominent aircraft companies, are illustrated here. Many others have been built for producing jet engine parts, wing sections, landing gear and similar components. May we tell you more about our ability to produce machine tools for your present and future requirements? Our engineers will be glad to work with you.

Special Machine Tool Division

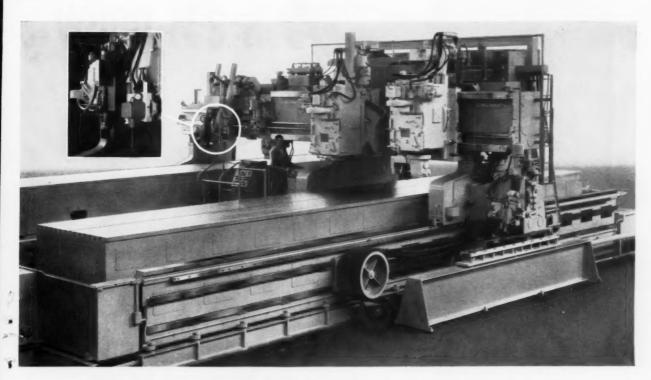
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO



CINCINNATI

6-MACHINERY, July, 1957





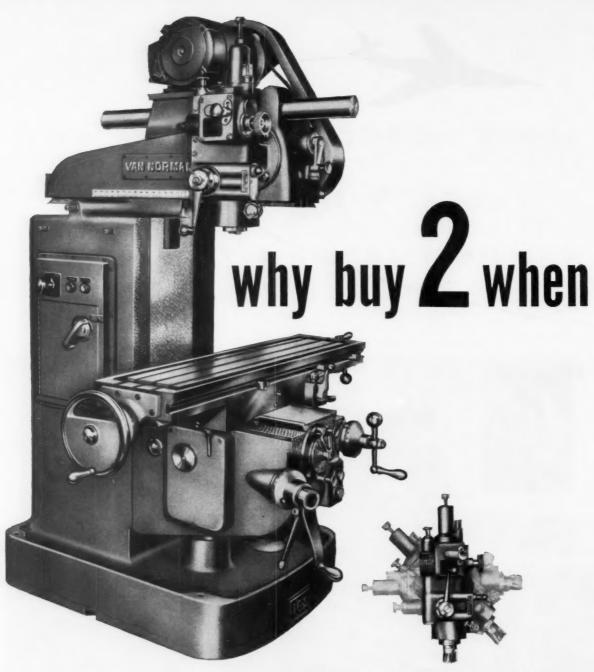
Versatility and productive capacity rate equally high in this CINCINNATI Aircraft Milling Machine. Some of the operations performed by the machine include horizontal and vertical spindle cuts in aluminum, steel or titanium skins; twist milling; line tracing from a drawing; 360° tracing; depth tracing. For "twist"

milling operations, the left-hand head swivels 30° right and left while taking a contour cut. Feeds and speeds may be selected to suit the job. Working surface—6 feet x 28 feet; template table—5 feet x 28 feet.

MILLING MACHINES • BROACHING MACHINES • CUTTER AND TOOL GRINDERS • METAL FORMING MACHINES HARDENING MACHINES • OPTICAL PROJECTION PROFILE GRINDERS • CUTTING FLUID • GRINDING WHEELS

For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-7



No. 16S — The most versatile miller available — features the quill type adjustable cutterhead that permits horizontal, angular and vertical milling plus boring and drilling. Table: 40½" x 10"; Quill Travel: 4"; Quill Power Feeds: .0015; .003; .006; Cutterhead Spindle Motor: 2 HP; Speeds: 110 to 3600.

VAN NORMAN MACHINE

MANUFACTURERS OF — Ram and Column Type Milling Machines, Cylindrical Grinders, Spline and Gear Grinders, Oscillating Radius Grinders, Special Production Grinders, Centerless Grinders.

8-Machinery, July, 1957

ONE Will do... When it's a van norman Ram type miller

A single investment in ONE Van Norman ram type miller gives you the equivalent of two single purpose machines plus attachments. And at a much lower cost.



No. 16M — a heavy duty miller designed for maximum rigidity and accuracy. Table: 40½" x 10"; Ram Travel: 20½"; 3 HP Cutterhead Spindle Motor; Speeds: 50 to 2000



This adjustable cutterhead, on the Van Norman 16L & 16M, gives you two millers in one. It enables you to do horizontal, angular or vertical milling, minimizes work reset-ups, cuts idle machine time and tooling costs.



No. 16L — designed to increase production and cut costs in toolrooms, machine shops, pattern shops and on production lines. Table: $40\frac{1}{2}$ " x 10"; Ram Travel: $20\frac{1}{2}$ "; Cutterhead Motor: 2 HP; Speeds 84 to 2760.

Get complete details on the Van Norman 16S, 16L, and 16M today. Write, wire or telephone for catalog.

COMPANY

SPRINGFIELD 7, Massachusetts Don't wait . . . for extra profit install a Van Norman machine now! They are available on several purchase plans . . . Outright sale . . . On conditional sales contract up to five years . . . Pay as you depreciate up to 10 years. Conditional Sales Contracts not available to Export.

Exclusive features make Landis universal grinders a "best buy"

Here's where they will save time...reduce grinding costs:

Jobbing Machine Shops Maintenance Shops Tool and Die Shops Training Shops



Landis 10" x 20" Type H Precision Universal Grinder

precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA



Fully universal wheelhead for fast setup

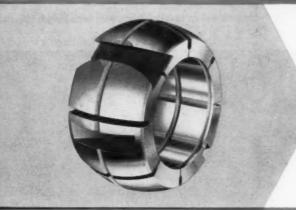
Easy hand swiveling with exclusive Landis wheelhead swivel mechanism.



Swinging internal grinding fixture for fast *change* of setup

Quickly lowers for internal grinding; locks securely and rigidly; swings up out of the way; no exposed belts.





Microsphere bearings for close tolerances and fine finishes

Closest running clearance of any spindle bearing; gives sensitive response to wheel feed, quick sparkout, dependable operation.

Fully universal headstock for ease of operation

Compact, low design; only two revolving parts. Variable speed control by rheostat. Swivels for angle or face grinding.



REDUCE COSTS
ON









PIERCE

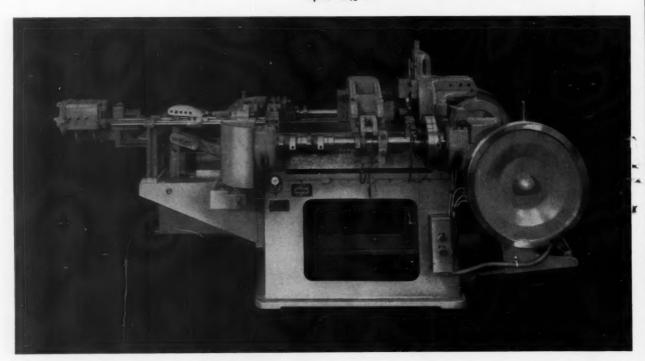
WITH

PIERCE

BEND

U. S. MULTI-SLIDES®

Below: The No. 33 U. S. Multi-Slide used with appropriate tooling to produce the formed metal stamping illustrated on the opposite page. The No. 33 Multi-Slide has a capacity for material up to $2\frac{1}{2}$ " wide, with feed length adjustable up to $12\frac{1}{2}$ ".



Formed metal stamping produced complete on the U. S. Multi-Slide. Drawings below indicate the progressive operations in the dies and forming position.







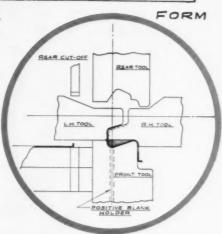


CUT- OFF

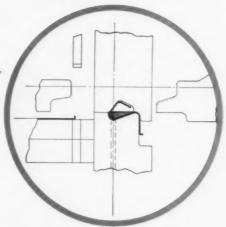
If you produce formed metal stampings, the U. S. Multi-Slide may be the answer to your cost reduction problems. The part illustrated is just one of the many different types of stampings that can be produced complete on the U. S. Multi-Slide—without secondary handlings. The combination of ram action, four-slide forming, vertical stripper, and various auxiliary units allows for the designing of tools to produce intricate parts complete—without the need for secondary operations . . . and every such operation that can be eliminated increases your profit potential.

Since these movements are an integral part of the machine equipment, it is not necessary to build complicated movements into the dies themselves, thereby giving the added advantage of reduced tool maintenance cost.

Investigate! Ask for a copy of Bulletin 15-A, or send us samples or drawings of your parts for our recommendations.



Operations in the forming position: Above: front, right-hand and left-hand tools entered to preform part around post. Below: right-hand and left-hand tools retracted; front and rear tools entered to complete the form.



U. S. TOOL COMPANY, Inc.

AMPERE (East Orange)

NEW JERSEY

Builders of U. S. Multi-Slides — U. S. Multi-Millers — U. S. Die Sets and Accessories — U. S. Automatic Press Room Equipment

REDUCE COSTS
ON
FORMED STAMPINGS







PIERCE

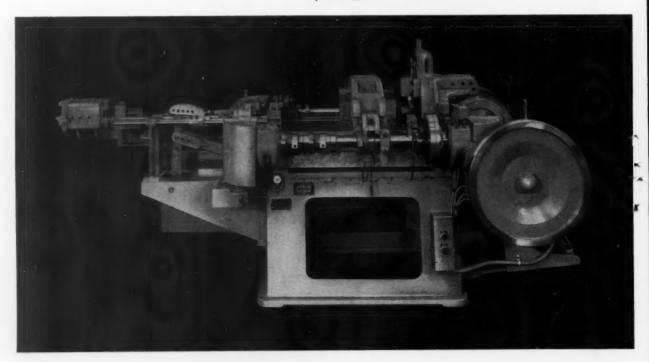
WITH

PIERCE

BEND

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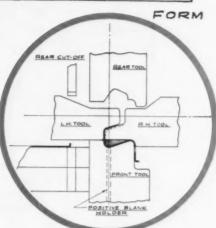


CUT- OFF

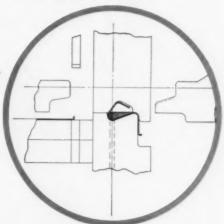
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U. S. TOOL COMPANY, Inc.

AMPERE (East Orange)

NEW JERSEY

Builders of U. S. Multi-Slides — U. S. Multi-Millers — U. S. Die Sets and Accessories — U. S. Automatic Press Room Equipment

Unique Combination of Snyder Special Two or Four Barrel Intake Manifold

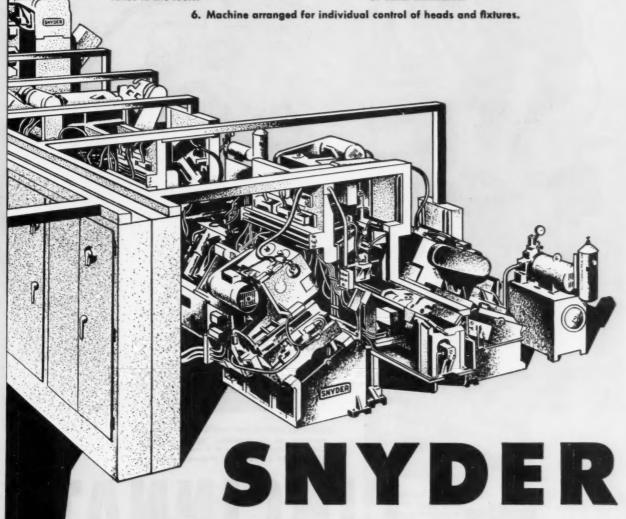


Transfer Machines Processes Either Castings from Rough to Finished Parts

Combination of two special transfer milling machines in parallel, with automation, feeding into one special transfer drilling machine gives production of 136 pieces per hour

Special Features of Snyder Machines Nos. 55-60 and 55-61

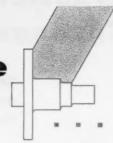
- Machine line handles two or four barrel manifolds, random intermixed; sensing devices automatically instruct the proper drilling and tapping units.
- Part rotated vertically 180° and horizontally 180° in various stations to present various faces to the tools.
- 3. Individual electrical panels and hydraulic units for each segment.
- Wing bases, sections, spacers and risers standard throughout for easy adaptation to future part changes.
- 5. J.I.C. Standards.



TOOL & ENGINEERING COMPANY
3400 E. LAFAYETTE • DETROIT 7, MICHIGAN

32 Years of Special Machine Tools with Automation

It Pays to Combine





CINCINNATI FILMATIC Angular Wheel Slide GRINDING MACHINE

Diameters and adjacent radii and shoulders are precision ground in one operation on this CINCINNATI FILMATIC $10^{\prime\prime}R$ x $18^{\prime\prime}$ Angular Wheel Slide Grinder. Sizes available: $6^{\prime\prime}R$ and $10^{\prime\prime}L$ x $18^{\prime\prime}$ or $30^{\prime\prime}$ between centers; $10^{\prime\prime}R$ and $14^{\prime\prime}L$ x $18^{\prime\prime}$ to $72^{\prime\prime}$ between centers.



CENTERTYPE GRINDING MACHINES . CENTERLESS GRINDING MACHINES . ROLL GRINDING MACHINES . SURFACE

16-MACHINERY, July, 1957

Precision Grinding Operations

Especially on a CINCINNATI Built for the Job

Time, effort and dollars are saved when operations are combined. And quite often quality improves, just as it does when diameters and adjacent radii and shoulders are ground in one operation on CINCINNATI® FILMATIC Angular Wheel Slide Grinding Machines. These fine precision grinders are built for high production work at the lowest cost of any equipment available today. Many features contribute to this outstanding performance. Four are illustrated at the right. Others include:

Push-button automatic grinding cycle, incorporating coarse and fine feed rates for maximum production and high-quality finish.

Roll-out cutting fluid tank. Cuts down service attention.

*Automatic air-electric gage sizing with cycle time stabilizer. High degree of accuracy and compensation for wheel wear obtained automatically.

*Automatic gap eliminator. A timesaver where stock allowance varies widely.

*Behind-the-wheel profile truing equipment, for automatic, accurate profile truing in both directions.

Additional features and their advantages are illustrated and described in catalog No. G-686. Everyone concerned with modern precision grinding methods and low costs should have a copy. May we hear from you? Meanwhile you might want to look at the brief specifications in Sweet's.

*Available at extra cost.

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO





FILMATIC grinding wheel spindle bearings, exclusively CINCIN-NATI, have never been equalled by any other spindle bearing mounting.



Automatic grinding wheel balancing, an exclusive CINCINNATI feature, balances the wheel and mount within a few seconds.



Automatic hydraulic table clamp automatically locks the machine table in position during the grinding cycle.



Manual flagging device, for locating the work axially with respect to the wheels, is simple and accurate. Automatic flagging device is also available.

GRINDING MACHINES . CHUCKING GRINDERS . MICRO-CENTRIC GRINDING MACHINES . CENTERLESS LAPPING MACHINES

For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-17

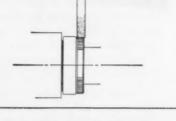
The more you grind the more you save with Norton...

cost-cutting operations

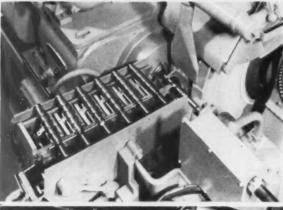
Typical automatic features on Norton grinders



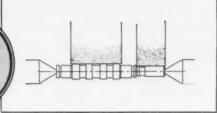
SAVINGS ON Transmission Gears



In a Type CTU Cylindrical Grinder arranged for completely automatic loading, grinding, and unloading of transmission gears, the part is held on a chuck and grinding cycle is terminated by an automatic air-electric grinding gage that signals when work is to size.



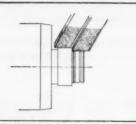
SAVINGS ON Valve Pistons



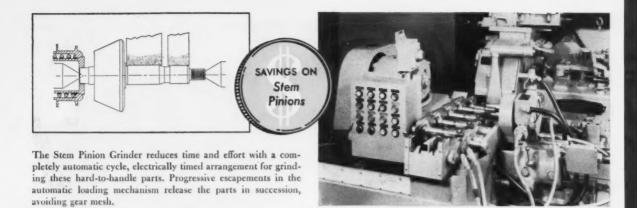
When a Type CTU Grinder is arranged for fully automatic loading and grinding of valve pistons the part is held on centers and driven by a floating type collet. Work is ground by a double-wheel mount.



SAVINGS ON Transmission Sleeves



On this Type CV-4 Angular Wheelslide Grinder chucked grinding of transmission sleeves is arranged in a completely automatic cycle. Longitudinal movement of a revolving turret loads the machine. A stripper type plate removes the piece when turret retracts as the grind is terminated by electrically timed control.



NEW ECONOMY!

Norton No. 2 Unitized Transfer Grinder Grinds Crankpins Automatically

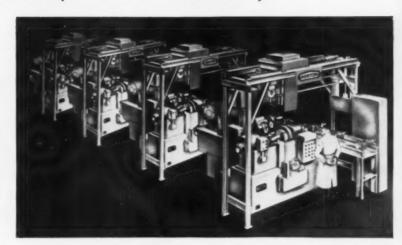
Here's a newly developed machine that automatically grinds crankpins faster and for less money than ever before possible. Advanced features like the following are reasons why:

Unitized Operation. Each grinding station, operating independently, can be automatically by-passed without affecting continuous production.

New Transfer Mechanism. Double set of hooks speeds loading, unloading and transferring of crankshafts from one grinding unit to another.

Fost Production. Cycling grinds 240 crankpins on 60 V-8 crankshafts per hour, due to many automatic operations.

Only One Operator Needed. Others are freed for different jobs. And the machine reduces floor-space requirements.



Norton has developed a wide range of fast, automatic grinders. You can get them in conventional and angular wheelslide types — also in special types for grinding automotive valve faces and crankshaft pins.

Remember: only Norton offers you such long experience in both grinding machines and wheels to bring you the "Touch of Gold" that helps you produce more at lower cost.

For further information about these machines — including how the No. 2 Unitized Transfer Crankpin Grinder can save you many dollars daily — contact your Norton Representative. Or write to Norton Company, Machine Division, Worcester 6, Mass.

District Offices:

Worcester • Hartford • Cleveland • Chicago • Detroit

To Economize, Modernize with NEW



GRINDERS and LAPPERS

Making better products ... to make your products better

NORTON PRODUCTS:

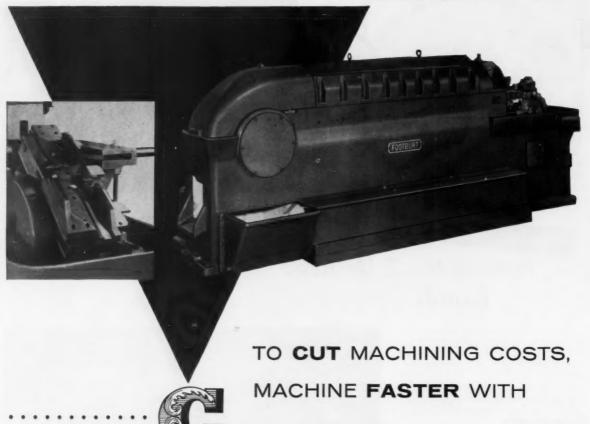
Abrasives • Grinding Wheels • Grinding Machines • Refractories

BEHR-MANNING DIVISION:

Coated Abrasives • Sharpening Stones • Behr-cat Tapes

For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-19



ontinuous broaching

Higher machining production than ever achieved by any other method has been made possible in many cases through the use of the Footburt Continuous Surface Broaching Machines. In most cases, production is limited only by the speed at which parts can be loaded into the self-clamping fixture. Unloading is automatic. If you have a problem of high production on small parts, send blueprints and hourly requirements.

THE FOOTE-BURT COMPANY
Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

ENGINEERED FOR PRODUCTION

FOOTBURT

PIONEERS IN SURFACE BROACHING

20-MACHINERY, July, 1957

Write for Circular No. 503

For more information fill in page number on Inquiry Card, on page 259

new.

BH Bond
cuts grinding costs
in rough snagging operations

Gardner's new BH Bond gives:

longer disc life

BH Bond is tougher, more heat-resistant

higher production

eliminates frequent disc changing

greater efficiency

more production per disc

BH Bond can be supplied in all standard disc sizes

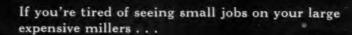
GARDNER

abrasive discs

BELOIT, WISCONSIN



what's the DIFFERENCE...



If you're tired of extra set-ups because your miller has only a single head . . .

If you're tired of whittling away at rugged jobs with low power heads . . .

If you're tired of complicated controls that make your operator a mountain goat . . .

this new

CRAY HANDYMILL

is for you

Built in a wide range of high horsepower sizes, with great variety in head combinations, simplified pendant control, it fills a long standing need for a powerful, rigid, milling machine for medium sized jobs.

The G. A. GRAY Co., Cincinnati, Ohio



what's the DIFFERENCE...



To you, the user or buyer, the most important difference between MARVEL High-Speed-Edge Hack Saw Blades and ordinary blades is the unequalled performance you get from MARVEL Blades.

Performance reflected in higher production (faster cutting-off), greater accuracy of cut-off blanks, and longer blade life has made MARVEL the preferred blade in every kind of metal sawing operation.

To get the difference in performance, always insist on MARVEL High-Speed-Edge Hack Saw Blades. Leading Industrial Distributors have them in stock.

Write for "The MARVEL Story." It has complete details on MARVEL High-Speed-Edge Hack Saw Blades and Hole Saws.

HIGHER PRODUCTION

Unbreakable MARVEL High-Speed-Edge Blades can be worked faster and harder than any other blade with complete safety. They will withstand the highest speeds and heaviest feeds attainable on any make hack sawing machine. MARVEL Blades will cut any machineable metal. No wasted time changing blades for different materials.

GREATER ACCURACY



Composite construction permits MARVEL Blades to be tensioned from 200% to 300% more taut than ordinary blades. This produces greater rigidity of the high-speed-steel cutting edge, resulting in maximum obtainable accuracy of cut-off blanks.

LONGER BLADE LIFE



Each MARVEL High-Speed-Edge Mack Saw Blade is triple tempered to assure maximum toughness of the cutting edge. MARVEL Blades not only give you longer life, they assure a more efficient cutting life, with resulting lower blade costs.

B-1121

ARMSTRONG-BLUM

MFG. CO.

5700 WEST BLOOMINGDALE AVE. . CHICAGO 39, ILL.

MARVEL SAVS.

Better Machines-Botter Blades

LOOK AT IT CALMLY No sense being disturbed by GRINDING WHEEL PROBLEMS when there's an easy solution in sight. Switch to CINCINNATI (PD)° WHEELS. Now Cincinnati Grinding Wheels offer POSITIVE DUPLICATION—a remarkable achievement in precision manufacturing and quality control that can save you money . . . and increase your production. You'll see for yourself why everybody's talking about (PD) WHEELS. Through the CINCINNATI (PD) Manufacturing process you are assured Positive Duplication of the original wheel every time you reorder. "On grade" with a CINCIN-NATI (PD) WHEEL means all future (PD) WHEELS will act and grind exactly alike. Yet CINCINNATI (PD) WHEELS are priced no higher than ordinary wheels. So if you want to keep calm in the face of Grinding Wheel problems, see your CINCINNATI Grinding Wheels Distributor. He'll be glad to explain how (PD) WHEELS can save you money and increase production. Or, contact us direct and we'll send one of our representatives-men who know grinding and grinding machines as well as grinding wheels. Write, wire or telephone Sales Manager, Cincinnati

For more information fill in page number on Inquiry Card, on page 259

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO. Grinding Wheels

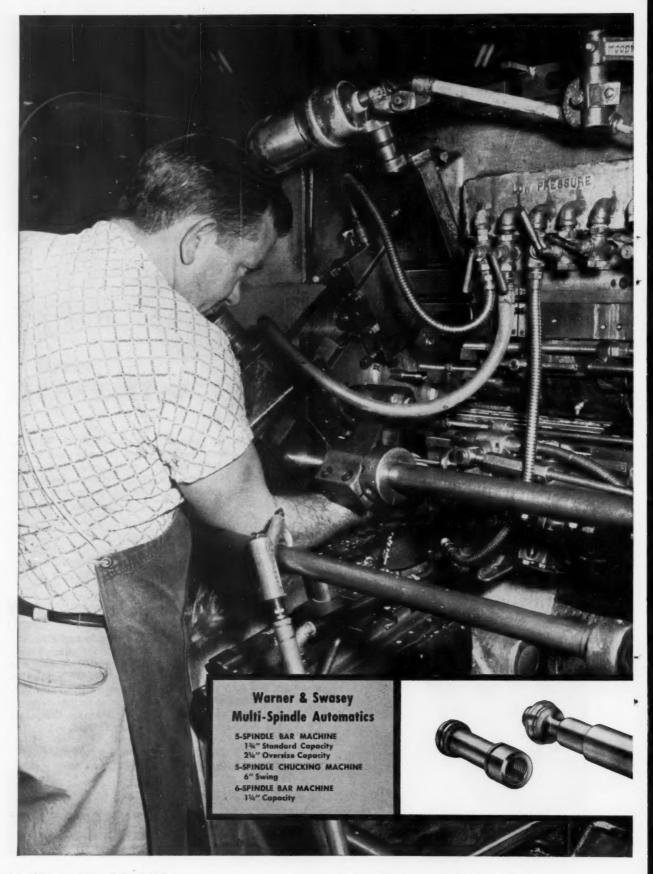
Milling Products Division, Cincinnati 9, Ohio.

Remember-only CINCINNATI Grinding Wheels give you

POSITIVE DUPLICATION

Trade Mark Reg. U. S. Pat. Off.

MACHINERY, July, 1957-25



WARNER & SWASEY AUTOMATIC CUTS SMALL LOT COSTS...

solves inventory problem for Cleco Division, Reed Roller Bit Company

Cleco Division, Houston, Texas, manufactures a wide variety of air tools. About 6000 different component parts must be machined each year—and, in order to keep reasonable inventory, in relatively small lots ranging from 100 to 1000 pieces.

While production on small hand-operated turret lathes kept inventory in line, it resulted in too high a cost per piece. On the other hand, economical production on conventional automatics required larger lot sizes and higher inventories.

In 1948, Cleco installed a Warner & Swasey 5-Spindle Automatic to solve both these problems. Its quick setup permits machining small lots at automatic rates—reducing cost per piece, and inventory at the same time.

This automatic has been operated on a twoshift basis—the equivalent of 16 years of one-shift production—with an exceptionally low record of downtime. Only \$144 has been spent for repair parts. And despite this usage, cross slide form cuts to within .002" are easily held.

Foreman O. R. Palmer says: "We handle as much of our short run work as possible on the Warner & Swasey. Only when there's more such work scheduled than the machine can accommodate do we route the surplus to other automatics." Cleco operators like the automatic's quick-set quadrants which eliminate cam changing for feed strokes, its micrometer-dial cross slide adjustment, and general ease of operation.

If you'd like to reduce your machining costs on small and medium lot production—as well as long runs—call in our Field Representative. He'll be able to tell you whether your work can be done more profitably on a Warner & Swasey Multi-Spindle Automatic.





YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

吗

DETROIT BROACH

In the Production Picture with Industry's Leaders

LOCATION: Melrose Park Works, Melrose Park, III.



FOUR FACES EVERY 24 SECONDS



Removes 225 Pounds of Tough Forged Steel per Hour

The mammoth International TD-24 Crawler Tractor features "live" power and "live" traction on both tracks . . . and these tracks depend on tough forged steel links to deliver both. What's more, it takes smooth, controlled power to machine the links to close tolerances at high production rates . . . and that's exactly what's delivered by the Detroit Broaching Machine that does the job! Here are the facts:

PART: Forged steel track link, Rockwell C32-38.

MACHINE: Detroit Vertical Twin Slide, 25-ton broaching capacity, 100-inch stroke.

OPERATIONS ON EACH SLIDE:

R.H. Station: Broach locating slot, straddle broach parallel sides.

L.H. Station: Broach diagonal keyway; (As one slide is broaching, fixtures on other slide are unloaded and reloaded.)

STOCK REMOVED—Approximately 5 cubic inches per piece. Cuts from the parallel sides and keyway are 0.150", balance is removed from the locating slot. Hourly stock removal is 225 pounds.

TOTAL BROACHING TIME PER PIECE: 24 seconds.

This Detroit Broaching Machine is one of several installed by International Harvester . . . and one of hundreds "in the production picture with industry's leaders." Let Detroit Broach offer the solution to your production machining problem, including the right machine, the most efficient tooling, and automation to any degree required. Send parts, prints or details of your problem for prompt recommendations.



Write for these Broaching Machine bulletins:

- · Vertical Twin Ram
- · Vertical Single Ram
- · Vertical Pull Down
- · Horizontal Internal
- · Horizontal Continuous
- Hydraulic Presses



Tooled and fixtured by Detroit Broach specialists, the two-slide machine broaches four surfaces on each workpiece. The fixtures clamp parts hydraulically, are tilted down for broaching by shuttle action of the machine's knee. As one ram is broaching, fixtures at other are unloaded and reloaded.



This rugged, push-shearing action is accomplished smoothly with the "live" power of the International TD-24. A similar action in machining its tough forged steel track links is performed by Detroit Twin Slide Vertical Surface Broaching Machine.

DETROIT BROACH & MACHINE COMPANY

DEPARTMENT B-7 . ROCHESTER, MICHIGAN

For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-29



The accuracy and finish of small bearing races ground on this Gardner 77A-12" double spindle grinder save the cost of a former lapping operation.

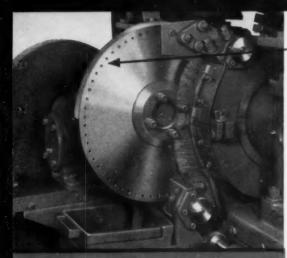
grinds TWO parallel surfaces in ONE operation





Gardner grinder cuts costs

close tolerances and quality finish eliminate lapping operation



Rotary carrier passes work between abrasive discs

production data

Part: Small inner bearing race Operation: grinding parallel sides .0005" uniformity

GARDNER

.0001" squareness

precision disc grinders BELOIT, WISCONSIN Precision by the Truckload - - they're Blanchard ground!

This truck is loaded with 14 tons of steel. Its cargo is 33 soft steel plates, each measuring 271/2" x 251/2" x 11.125", and ground to ±.001" on a Blanchard Surface Grinder.

Dies up to 84" across corners, can be ground on a Blanchard at great savings. Grinding can be controlled without guesswork - leaving a flat, sharp die -as soon as the entire surface is cleaned up. Die resharpening on the Blanchard allows you to get maximum life from your valuable dies and end plates.

Ask for details on the 15 standard Blanchard models.

For best results in surface grinding . . .

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY 64 STATE ST., CAMBRIDGE 39, MASS.

THE BLANCHARD MACHINE CO., 64 State St., Cambridge 39, Mass.

Gentlemen: Please send me a free copy of "The Art of Blanchard Surface Grinding" (3rd edition) and "Work Done on the Blanchard" (5th edition)

HOW IT'S DONE with Giddings & Lewis



You're looking at a production line which consists of fifteen Cincinnati Bickford Super Service Radials (with 3' to 6' arms) that speed manufacturing operations of a leading earthmoving equipment line. Radials handle all boring, drilling, reaming, tapping and facing operations on rear axle housings, differential carriers, cylinder hoists, and other components for 7 to 25-yd. scrapers, rear-dump and bottom dump haulers, etc.

Here's a good yardstick for measuring production methods

Compare your own operations with these performance stories done on Giddings & Lewis machines . . .





E. W. Bliss reports: 9 G&L machines

standout performers

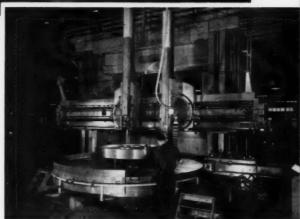
producing metalworking presses...

They're counting on high-production G&L performance to build high-production mechanical and hydraulic presses at E. W. Bliss Company's Toledo Division. They're getting the profitable results they want with nine Giddings & Lewis machines.

Included are eight Horizontal boring, drilling and milling machines — two each of Models 350-T, 330-T and 360-F... one each of Models 560-T and 570-FUAR, and a 12-ft. Vertical boring mill.

Pictured above is a typical example of the precision machining performed on G&L machines. The Model 570-FUAR (floor-type) Horizontal with underarm support is being used for rough and finish line-boring of the cast-iron crown for a Bliss mechanical trimming press. Flanges and bearing seats are rough and finish milled on the G&L.

For complete specifications on G&L's broad line of heavy-duty machines, write for general Catalog No. 57.



Shown here is the G&L 12-ft. Vertical boring mill being used to face, turn and bore various inside and outside diameters on the main driving gear blank of a Bliss mechanical press. Job is performed in one setup.

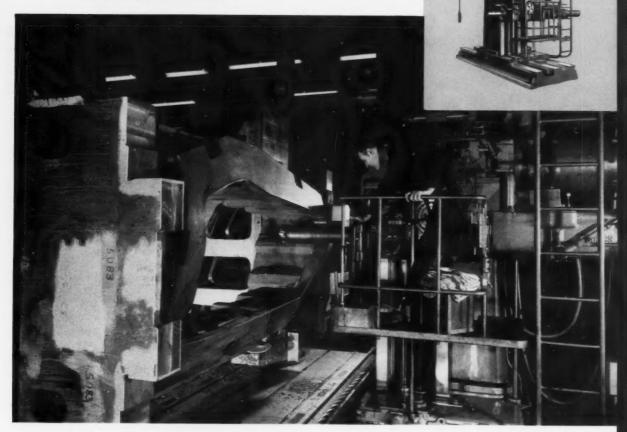


G & L and HYPRO DIVISION GIDDINGS & LEWIS MACHINE TOOL CO.

FOND DU LAC, WISCONSIN

Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines — table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines: Vertical Boring Mills; Spar and Skin Milling Machines and VARIAX Milling Machines

At De Luxe Die Works this G&L Model 360-F (floor-type) Horizontal rough and finish-mills 13 large wear plate areas and 4 small keeper pads in upper die shoe with 8" dia. face mill. The 8½-ton die forms the left rear fender of a 1958 model car.



G&L dependability demonstrated at De Luxe! precision machining fender dies...

Five G&L Horizontals work two shifts daily producing both large and small dies

"These G&L's are busy 18 and 20 hours a day," remarks Richard L. Dahl, shop superintendent at De Luxe Die Works, East Detroit, Michigan.

One of the largest automotive tool and die builders in the country, De Luxe precision-machines large and small dies on Giddings & Lewis Horizontal boring, drilling and milling machines. Dies are used in production of automobile quarter panels, hoods, deck lids, front and rear fenders.

The 8½-ton cast iron shoe (illustrated above) requires approximately 50 hours machining time on a G&L Model 360-F (floor-type) Horizontal with 6" dia spindle. Thirteen large wear

time on a G&L Model 360-F (floor-type) Horizontal with 6" dia. spindle. Thirteen large wear plates are rough and finish-milled using an 8" dia. face mill with high-speed cutters. All heels and safety pads are rough and then finish-milled.

Other G&L Horizontals include: Model 350-T (table-type) and a No. 56-T (table-type) with special attachment for profiling and contour milling of air-hardened steel dies. Smaller dies

are bored, drilled and milled on two Giddings & Lewis No. 45-T (5" dia. spindle) precision horizontals. One is equipped with a 52" x 108" table, the other with a 40" x 84" table.

Model 360-F Horizontal is one of 24 Giddings & Lewis floor-type machines available with main spindle diameters from 5" through 14" — motor drives from 20 through 150 hp — larger machines available with underarm spindle support.

For complete specifications on the 30 Series (floor-type) Horizontal machines, see your nearest Giddings & Lewis representative, or write for Catalog No. 30-F.



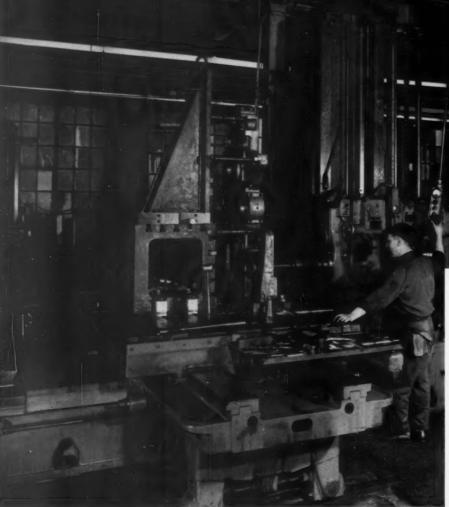
G & L and HYPRO DIVISION GIDDINGS & LEWIS MACHINE TOOL CO.

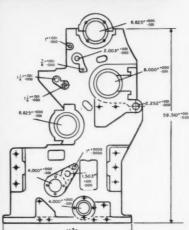
FOND DU LAC, WISCONSIN

Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines — table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines and VARIAX Milling Machines.



with Giddings & Lewis...
building offset printing presses







Production sequence shown in pictures

Before machining starts, main frame for the offset press is squared vertically and horizontally on the table and with centerline of the machine spindle. Machine's automatic electric positioning device maintains tolerances and distances between centerlines of various size bores.

- 1. Two 6.625" bores for plate and impression cylinders—rough, semi-finish and finish-bored to .001" tolerance. Davis boring bar (4" dia., 10" long) and two-cutter blocks with expandable cutters used for rough boring at 102 rpm, .025 ipr feed.
- 2. The 8.000" bore for blanket cylinder—rough, semi-finish and finish-bored... also back-faced with a Davis 11.125" facing cutter. Rough boring is with a Davis block-type cutter at 89 rpm, .025 ipr feed.



3. This 2.003" hole is drilled first with a 1" drill and then with a 1%" drill before it is rough, semi-finish and finish-bored. Rough boring is accomplished with a Davis block type cutter at 329 rpm, .025 ipr feed.

Unwavering precision

...key reason why Harris-Seybold's Cleveland Division makes wide use of Davis standard tools on precision bearing operations

High product quality has made Harris-Seybold, Cleveland, a recognized leader among makers of offset lithographic presses. Use of Davis boring bars and cutting tools at the company's Cleveland Division, where the largest presses are made, is in keeping with this reputation.

Davis block-type general purpose boring bars with interchangeable cutter blocks are used for *virtually all* precision boring operations on press main frames. Machinists report Davis block type cutters last longer, require far less frequent sharpening. They're pleased, too, with the fact that Davis carbide cutting tools are ideal for high

speeds and feeds.

Shown at left is the machine on which these standard Davis boring tools demonstrate unwavering precision. It's a Giddings & Lewis Model 350-T (table-type) Horizontal with 5" spindle, 60" x 96" table, 120" bed, extended saddle and saddle supports, in-the-floor type auxiliary runways. Its automatic electric positioning device ends time-consuming fine hand adjustments . . . permits automatic setting of headstock and table . . . assures accurate, repetitive machine settings to .0002"

19 Giddings & Lewis machines contribute to Harris-Seybold quality

In addition to the Model 350-T Horizontal described above, there are five Cincinnati Bickford 4-spindle 24" Super Service gang drills . . . one 24" round column upright . . . two 3'-11" radial (12-speed head) . . . two 4'-11" radial (36-speed) . . . three 6'-19" radials . . . one 5-spindle upright . . . one Model 330-T and 50-T Horizontal . . . two HYPRO planer-millers (84" x 84" x 16').

You'll find the boring tools you want in the complete Davis line. See your local Davis sales representative or write for Catalog No. 304.

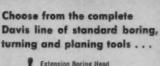


DAVIS BORING TOOL DIVISION

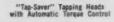
GIDDINGS & LEWIS MACHINE TOOL CO.

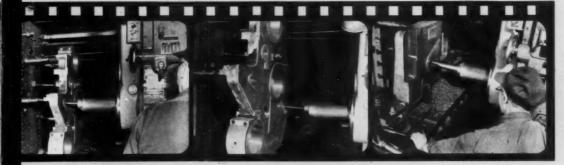
FOND DU LAC, WISCONSIN

Line and Stub Boring Bars, Boring Heads, Block Type Cutters, Planing and Turning Tools, and Special Production-Engineered Job Tooling.











Davis productionengineered tooling designs . . .

Special spherical boring tool designs are typical of Davis custom tooling service. Feel free to call on us for special-design solutions to your machining problems.

- 4. This 1¼" hole is drilled rough, semi-finish and finish-bored. Rough boring is with Davis block type, doubletip cutters at 375 rpm. .025 ipr feed.
- 5. This 2.252" hole is drilled rough, semi-finish and finish-bored. Rough boring is with a Davis two-cutter block with expandable cutters at 329 rpm, .025 ipr feed.
- 6. Two 4.000" holes are finish-bored to plus .000", minus .001" with Davis two-cutter block with expandable cutters at 160 rpm, .025 ipr feed.

HOW IT'S DONE with Giddings & Lewis

machining dies in East Detroit...

Intricate, precision die machining operations profitably handled

Giddings & Lewis Model 340-T (table-type) Horizontal pays its way with precision performance at Supreme Impression & Mold Co.

Supreme is one of America's major die-cast die producers. The company's precision-made products are used in casting magnesium, aluminum and zinc components for the automotive and appliance industries.

Pictured at work below is Supreme's G&L Model 340-T (table-type) Horizontal boring, drilling and milling machine — 4" diameter spindle, with 48" x 72" table, 48" column, extended saddle and saddle supports, in-the-floor auxiliary runways. Workpiece in a cover-half die to be used for casting TV-receiver screen frames. Weighing approximately 2500 lbs, the die is Crucible CSM-2, preheat treated to 280-310 Brinell. The G&L Hori-

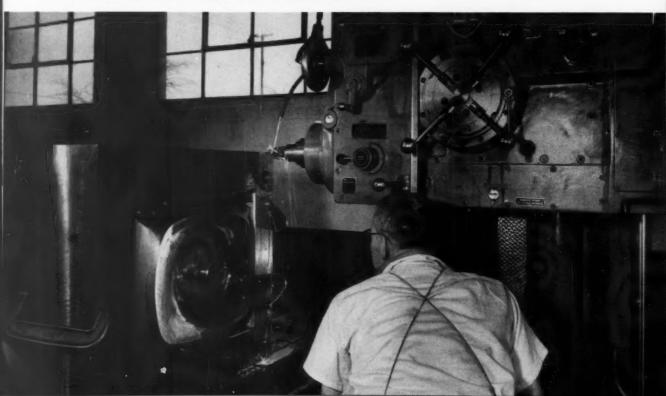
zontal removes more than 300 lbs. of metal in the following production operations:

- 1. Die edges rough and finish milled using 14" face mill with ten high-speed cutters. Finish cuts at 20 rpm, .010" feed per tooth.
- Clamp slots milled and eye-bolt holes bored. Four 2½" leader-pin holes precision drilled, bored and reamed (bushings also precision bored).
- 3. Ejector plate and rails are face-milled with an end mill.
- 4. Ten core pin holes of various sizes are precision bored.
- 5. The 2" sprue pin hole is bored . . . taper-reamed on the cover-half of the die, straight-bored on the ejector half.
- 6. Four corners of cover-half is radius-milled with an end mill.
- Sixteen water line holes of various sizes (30" to 34" deep) drilled, reamed and pipe-tapped in both coverhalf and ejector half.



Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines—table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines, and VARIAX Machines.

LITERATURE! For complete specifications on G&L 30 Series (tabletype) horizontal boring, drilling and milling machines, ask for Bulletin No. 30-T.





Extra measure of power, speed and precision

That's what makes a G&L 570-T (table-type) Horizontal one of the busiest and most productive machines at Adamson United Company

This Akron, Ohio, company is an important producer of basic and special process machinery for rubber, plastics, plywood, chemical and other industries.

Metalworking production engineers at Adamson United are enthusiastic about the performance they're getting from their Giddings & Lewis Model 570-T (table-type) Horizontal with 7" spindle. Working on both horizontal and vertical surfaces, the G&L is shown above precision-machining on a 14-ton side-frame casting of a calender.

Equipped with a G&L 90° angular milling attachment, the Model 570-T is used to machine all window surfaces of the calender housing in a single setup. And equipped with the same angular attachment with stub boring bars, it is used for boring adjusting-screw and tie-bolt holes. Then, with the workpiece in horizontal position on the 60″ x 96″ rotary indexing table, further rough and finish boring is performed . . . and all external faces (not machined in vertical position) are faced to exact tolerances and angularity.

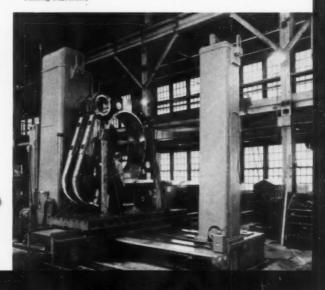
For complete specifications on G&L 50 Series Horizontal boring, drilling and milling machines, write for Catalog No. 50-T.

The Giddings & Lewis Model 570-T shown has continuous feed facing head and telescopic tool. It is shown precision boring a 65" dia. half-hole in two housings, set up side by side. All smaller boring operations are performed with Davis micrometer bar sets and block-type cutters.

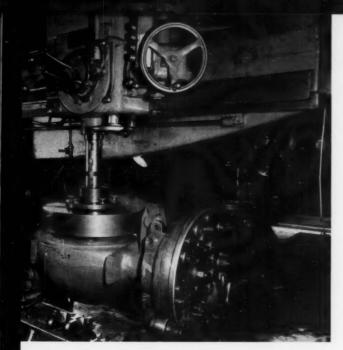
Here's the finished product—a 4-roll, Z-type calender. Each of its 14-ton cast-iron end frames is precision-machined on the G&L (table-type) Horizontal.

G & L and HYPRO DIVISION GIDDINGS & LEWIS MACHINE TOOL CO. FOND DU LAC, WISCONSIN

Builder of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines—table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines and VARIAX Milling Machines.







Here a specially designed spread facing head with single carbide tip cutter is being used for rough and finish facing of differential. Finish facing cut is performed at 245 rpm, .020" feed.

Fifteen Radials, with spindle speeds to 2300 rpm, used for drilling, tapping, reaming, facing, boring of rear axle housings, differential carriers and other vital earthmover components

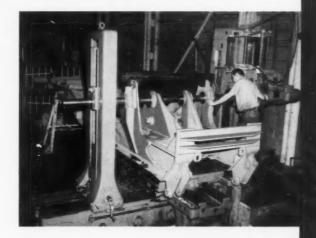
Proving their versatility on every production drilling job — these easy-to-operate Super Service Radials are key machines in the Cleveland plant expansion program of this industry leader. Company produces earthmovers for road-building and other projects — scrapers, rear-dumps and bottom dumps, ranging from 7 to 25-cu. yd. capacities.

In operation for more than nine years, the fifteen Cincinnati Bickford Radials with 3' to 6' arms (36 speeds, 18 feeds) have been the answer to increased production drilling. They are used with drill jigs to eliminate need for lengthy layout setups.

Super Service Radials demonstrate production drilling versatility

Here's typical production sequence in facing, drilling and tapping a heat-treated, cast-steel, 247-287 Brinell, 1000-lb rear-axle housing:

- 1. With workpiece clamped in an indexing trunnion fixture, four $1\frac{1}{164}$ and seven 1" holes are drilled and reamed on both flanges.
- 2. Differential mounting is rough and finish faced, using spread facing head with single carbide-tip cutter. Finish cut faced at 245 rpm, .020" feed.
- 3. Rough and finish $19\frac{1}{8}$ " dia. differential bore at 52 rpm, .006" feed, .003" tolerance.
- 4. Twenty-two .553-.556" holes are drilled, tapped, core-drilled and countersunk on differential face.
- Using jig fixture, ring gear clearance is cut with core drill. Six 35/4" holes are drilled in air chamber bracket.
- 6. Eleven different-sized holes are drilled for spring and radius-rod assembly.
- 7. Eight $3\frac{1}{2}$ " holes for spring bolts are spot faced at 85 rpm hand feed.



Another versatile machine in earthmover production — G&L Model 340-T (table-type) horizontal boring, drilling and milling machine

The Model 340-T with 4" dia. spindle, 48" x 72" table, performs rough, semi-finish and finish-precision boring of rear-axle, tandem-drive assemblies.

of rear-axle, tandem-drive assemblies. Four 64" dia. holes, spaced 12" apart, are precision bored to plus or minus .001". Mutual alignment of four bores must be practically perfect.

Providing for even greater machining possibilities, the Model 340-T is equipped with extended saddle and saddle supports, in-the-floor auxiliary runways, 36" x 36" indexing table, continuous feed facing and boring head, Davis boring bars and cutting tools.



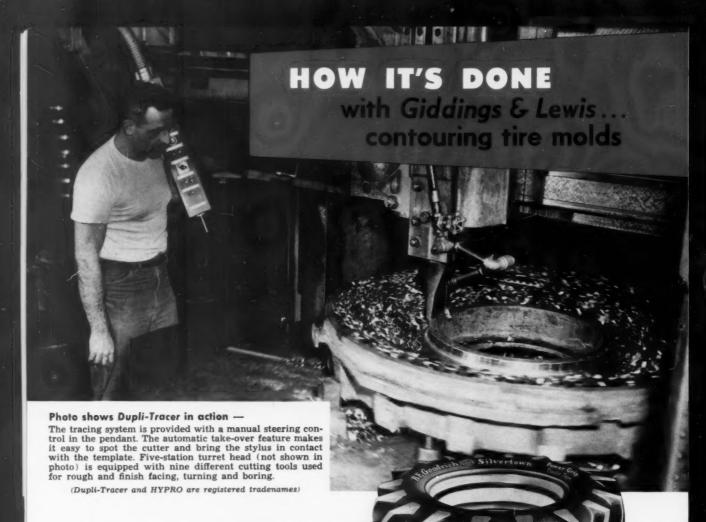
CINCINNATI BICKFORD DIVISION GIDDINGS & LEWIS MACHINE TOOL CO.

CINCINNATI, OHIO

Radial Drilling Machines, Upright Drilling and Tapping Machines, Gang Drills and Precision-Drilling Machines designed for use with Spacing table.



Get all the facts about Super Service Radials featuring complete hydraulic pre-selection of all 36 speeds and 18 feeds. Contact your nearest Cincinnati Bickford representative or write for illustrated bulletin.



Minimize chance for human error in mold contouring!

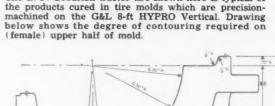
B. F. Goodrich does it! Uses Dupli-Tracer, 2dimensional electronic contouring control, on a G&L 8-ft HYPRO Vertical boring mill

They're enjoying a greater measure of accuracy — virtually complete freedom from human error — contouring tire molds at B. F. Goodrich in Akron, Ohio. This money-saving performance is credited to Gidding & Lewis 8-ft. HYPRO Vertical boring mill equipped with the electronic contouring control.

Equipped with a tracing head, this control assures precision contour-duplication of various radii and diameters from a master template. Constant chip thickness and constant cutting speed are maintained to produce a surface which is finished velvet smooth for tire-cure.



LITERATURE AVAILABLE! For all the facts about the ultra-sensitive 2-dimensional tracing and duplicating control — and specifications about HYPRO Vertical boring mills, see your G&L representative, or write for Catalog No. 54-12.



The B. F. Goodrich tractor tire shown here is typical of



G & L and HYPRO DIVISION GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN

Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines — table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines and VARIAX Milling Machines

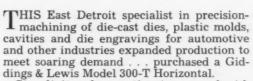
.... machining automotive dies and molds

G&L Horizontal steps up production to help meet 50% sales boost at Loehr Die & Mold Company

It's a Model 300-T (table-type)
Horizontal boring, drilling and
milling machine with 3" dia. spindle,
extended saddle and saddle supports,
in-the-floor type auxiliary runways



For complete specifications on G&L Models 300-T and 300-RT (revolving table-type) Horizontal boring, drilling and milling machines, contact your nearest G&L representative or write for catalog No. 300-T.



Simplicity of operation is assured with controls centrally located on the headstock for speed and accuracy. Forty-five spindle speeds, as low as 7 rpm, enables the operator to use the Horizontal as either a small or large milling machine for intricate precision die work. Additional advantages hailed by Loehr are the machine's full-length scales and verniers which permit locating hole centers to .001".

(Also on the job at Loehr Die & Mold Company, is a Super Service Radial with 5-ft. arm and 15" dia. column)

Here's a typical machining sequence:

Workpiece shown on Loehr's G&L 300-T Horizontal is a die-cast die block (40" x 42" x 6") which, when machining is completed, will be used in production of glove compartment doors for a brand new line of 1958 cars. Made of heattreated steel with Rockwell hardness C 30-32, the die block weighs approximately 1.7 tons before machining... must have 417 lbs. of steel removed.

- 1. Outer surfaces are milled with $8.5^{\prime\prime}$ dia. high-speed steel face mill.
- 2. Pockets roughed out (upper and lower half of die block) by manual steering made possible by directional control with a 2" dia. end mill at 60 rpm, .83 ipm feed and average 1¼" depth of cut.
- **3.** Four 2" dia. guide pin holes and bushings, 2" dia. sprue pin and bushing hole—rough and finish bored.
- 4. Pockets and inserts for the die are finish milled, holding plus or minus tolerances of .002".
- 5. Eight water line holes are drilled ($\%_{16}{''}$ dia., $15'' \ long)$.
- 6. Workpiece is then moved to Loehr's Cincinnati Bickford Super Service Radial which is used for drilling and reaming several ¼" and ¾" dia. ejector pin holes . . . drilling and tapping four ¾" dia. push back holes.



G & L and HYPRO DIVISION GIDDINGS & LEWIS MACHINE TOOL CO. FOND DU LAC, WISCONSIN

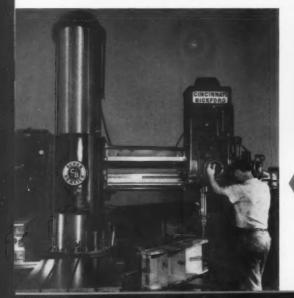
Builders of the world's finest beavy-duty Horizontal Boring, Drilling and Milling Machines—table, floor and planer types; HYPRO Double Housing and Openside Planers, Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines, and VARIAX Milling Machines.



HOW IT'S DONE with Giddings & Lewis ... precision drilling for

Drilling, tapping on angular column workpiece of SAE-1020 steel:

- Drill one 2¹⁵/₆₄" hole.
 Drill ten 1½₁₆" holes.
- 3. Drill one ¾" hole, core drill 2½" dia., core drill to 3¾" diameter.
- 4. Drill and tap fourteen %" leveling screw holes.
- 5. Drill ten 3/8" holes and tap .9" deep.
- 6. Drill six ¹³/₁₆" hold-down holes.
 7. Drill four ¹/₄" holes and tap .6" deep.





This Cincinnati Bickford Super Service Radial, (6-ft. arm, 19" dia. column) on 16-ft. dia. round floor plate, is used for production drilling of 24 workpieces clamped on parallels arranged 360 degrees around the machine. Setup permits continuous drilling, saves approximately 30% in floor-to-floor time. Picture shows reaming a 1.250" hole at 140 rpm, .016 ipr. Hole is also back spot-faced to 2½" dia.

world's <u>largest</u> builder of transfer machines

The Cross Co. saves up to 40% in setup and floor-to-floor time with Cincinnati Bickford Super Service Radials

When The Cross Company required precision, high-production drilling and tapping in the manufacture of their "Transfermatics," they chose a Cincinnati Bickford Super Service Radial. According to Burton Winke, shop supervisor, their first Super Service has now been in operation 15 years. It works 20 hours a day, six days a week — and has required only routine maintenance.

Today Cross uses eight Super Service Radials and one Super Service precision layout drilling machine with automatic spacing table. Other G&L machines at Cross include two Model 340-T and two Model 350-T Horizontal boring, drilling and milling machines.

Gets continuous production

One example of the savings achieved with these Radials is the drilling and tapping of 39 different radius holes in angular columns for Cross's multiple-spindle drilling slide units. Four of the angular columns are drilled and tapped on one side of the Radial, while another four are being set up on the other side. Production never stops, and the result is a saving of approximately 40% in setup and floor-to-floor time. Comparable efficiencies are obtained in the drilling, reaming and tapping of components for other Cross machines.

For complete specifications on the broad line of Super Service Radial Drills featuring choice of complete or partial hydraulic pre-selection, or lever control of all speeds and feeds, see your nearest Cincinnati Bickford representative, or write for new Bulletin.

In addition to the 6-ft. arm Radial, the Cross plant at Fraser, Mich., has an 8-ft. with a traveling base, another 6-ft. and five 4-ft. arm Super Service Radials for drilling and tapping a wide range of steel workpieces.



CINCINNATI BICKFORD DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.

CINCINNATI, OHIO

Radial Drilling Machines, Upright Drilling and Tapping Machines, Layout Drilling Machines, Gang Drills and Precision-Drilling Machines designed for use with Spacing Table.

Choose from these top-performing Cincinnati Bickford drilling machines



NEW SUPER SERVICE RA-DIAL DRILLS with complete hydraulic preselection of all 36 speeds and 18 feeds. Sizes: 13" column, 4' arm to 19" column, 8' arm.



MASTER SUPER SERVICE RADIAL DRILLS — available with 40 hp motors, sizes up to 26" col. and 12' arms. All types of bases including track type.



SLIDING - BASE SUPER SERVICE RADIAL DRILLS — —designed for high production, minimized setup time. All controls centralized on heads. In complete size range with 3' to 12' arms.



HIGH-SPEED SUPER SERV-ICE RADIAL DRILLS choice of 6 spindle speed ranges, from 3500 rpm down to 60 rpm with 3 hp motor. Available with 3' or 4' arms.



SUPER SERVICE PRECISION DRILLING MACHINE—specially suited to operations with automatic spacing table. For precision production work, its can be eliminated.



ALL-GEARED ROUND COL-UMN UPRIGHT DRILLS in three sizes (21", 24" and 28") with 9 to 12 speeds.



ALL-GEARED BOX COLUMN UPRIGHT DRILLS—24" unit with 5 hp motor, 28" with 5 or 7½ hp.

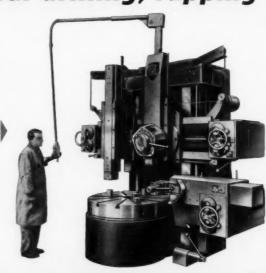


SUPER SERVICE BOX COL-UMN GANG DRILLS have entire mechanism in upper section. Each spindle is individually driven, saving time and space on successive operations.



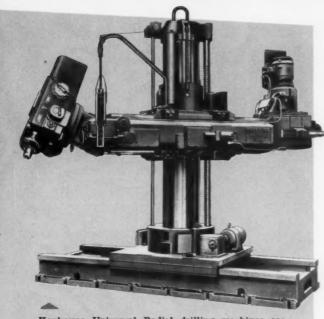
Extend your production profit range Kaukauna Horizontal drilling, tapping





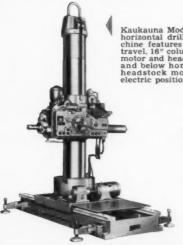
At Warner & Swasey, they perform radial, horizontal, angular and compound-angular drilling

all in one setup!



Kaukauna Universal Radial drilling machines are available in 6-ft. arm, 14" dia. column and 8'-10" arm, 9'-10" arm 22" dia. column, with spindle drive motors ranging from 2-20 hp. Complete pendant control of all powered machine functions including speed changing, column and runway movements . . . final tool location by electrical push button control. Bails, leveling jacks and spreader arms built-in . . . permit conveniently moving machine to work, eliminating hand drilling or tapping.

with rugged and boring machines



Kaukauna Model 1030 Tilting Head horizontal drilling and tapping machine features 3" spindle with 24" travel, 16" column. Has 7½, hp drive motor and head that tilts 45° above and below horizontal. All controls headstock mounted... complete electric positioning provided. KAUKAUNA MODEL 125-U UNIVERSAL RADIAL is used by Warney & Swasey, Cleveland, for drilling operations on lathe beds, and head castings of various sizes. Machinists consider this tilting head Kaukauna one of the safest and easiest-operating universal radial drills in the plant. They particularly like the fact that the Universal Radial can be securely

locked in any position for drilling, tapping

and spot facing operations.

At left, the Universal Radial is shown on the job — drilling, boring, tapping, counterboring and reaming more than 60 holes of varying sizes in turret lathe bed and head casting. Workpiece is hi-nickel iron (ASTM-A48, Class 50), weighing approximately two tons.

Here's the production sequence:

1. One $^{47}\!\!_{64}\!''$ hole drilled at 465 rpm, reamed at 30 rpm, .012 ipr feed.

2. Sixteen $^{27}\!\!\!/_4$ " holes drilled at 690 rpm, .007 ipr feed.

3. One $^{11}\!/_{\!32}{''}$ hole drilled at 690 rpm, tapped at 340 rpm.

4. Ten ²/₃₂" holes drilled 465 rpm, .012 ipr feed . . . counter-bored and tapped at 160 rpm.

5. Seven 17/32" holes drilled at 465 rpm, .007 ipr. feed . . . body counter-bored and tapped at 240 rpm, hand-feed.

6. One $^{55}\!\!_{64}{''}$ hole drilled 11" deep at 240 rpm, .007 ipr feed . . . reamed $9\!\!_{16}{''}$ deep at 160 rpm, .012 ipr feed.

7. Two $\%_{16}{''}$ holes drilled 4" deep at 690 rpm., .007 ipr feed.

8. Twenty-two $\%_{10}$ " holes drilled 2" deep at 690 rpm, .007 ipr feed . . . body counter-bored and tapped at 240 rpm, hand feed.

9. One $\%_{16}{''}$ hole drilled 3" deep at 240 rpm, hand tapped.

10. Two $2\frac{1}{32}$ holes drilled at 465 rpm, .012 ipr feed . . . back spot-faced 1" at 160 rpm, hand feed.

For facts about production profits, contact your Kaukauna sales representative.

For complete specifications and information on new line of Vertical Turret Lathes write for catalog VTL-3.



KAUKAUNA MACHINE & FOUNDRY DIVISION GIDDINGS & LEWIS MACHINE TOOL CO.

KAUKAUNA, WISCONSIN

Vertical Turret Lathes, Universal Radial Drilling Machines, Horizontal Drilling, Tapping and Boring Machines, Gray Iron Castings.



G&L Table Type Horizontal Boring, Drilling and Milling Machines



G&L Floor Type Horizontal Boring, Drilling and Milling Machines



G&L Planer Type Horizontal Boring, Drilling and Milling Machines



HYPRO Planer Typ Milling Machines



..

G&L Skin Milling Machines



G&L "Numericord," a Tape Control System for Machine Tool Automation



GAL "Variax" Multiple Axis Profile Milling Machines



HVPRO Openside Planers



HYPRO Double Housing



HYPRO Vertical Boring and Turning Mills



Cincionati Bickford Super Service "Radio Drilling Machines



Cincinnati Bickford Super Service" Uprigh Drilling Machines



Cincinnati Bickford "Super Service" Precision Production Drilling Machines



Cincinnati Bickford
"Super Service"





G&L Vertical Turret Lathes



Kaukauna Universal Radial Drilling Machines



Kaukauna Horizontal Boring, Drilling and Tapping







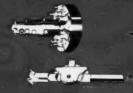
Davis Line Boring Bars and Block Type Tooling



Davis "Tap-Saver



Davis Planer Tools



Special Boring Tools

GIDDINGS & LEWIS MACHINE TOOL COMPANY

FOND DU LAC, WISCONSIN



— DEPENDABLE FORGINGS —

Ever since the beginning of the development of mechanical power, the heart of power producing machinery has been forgings.

The latest development in the field of mechanical power is the aircraft turbo-jet engine. Here again, the important highly stressed components — the turbine wheels and the compressor discs — are forgings and here also more of these forgings are produced by

Wyman-Gordon than by any other company.

Entirely new problems, mechanical and metallurgical, are involved in the production of these vital parts—problems which require the maximum in experience, know-how and research facilities. Wyman-Gordon excels in all of these areas and continues today as for nearly 75 years in the forefront of new forging developments.

Seen through the porthole of this compressor disc is the finished forging — an example of the ultimate in quality and precision.

WYMAN-GORDON COMPANY

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER 1, MASSACHUSETTS

HARVEY, ILLINOIS . DETROIT, MICHIGAN

MACHINERY, July, 1957-33

dixi 60

horizontal optical jig borer

with 5 optical microscopes

DESIGNED AND BUILT FOR:

VERSATILITY

Optical settings for operations in all planes and compound angles . . . Equally suitable for tooling, short-run or production work . . .

ACCURACY

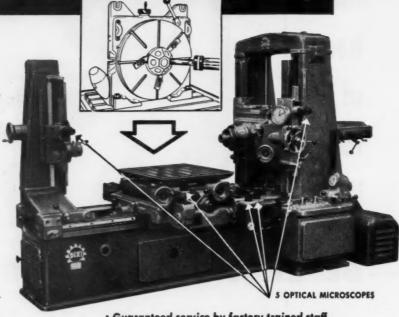
Overall accuracy of .0002"

A precision machine for JIGLESS boring, facing, milling, and drilling work, in all planes. Built-in 360° optical rotary table, 28%" x 32%". All spindle and table settings by optical microscopes. Infinitely variable hydraulic feeds. Mechanical spindle feeds with automatic depth stop. #40 taper spindle-speeds infinitely variable to 1400 R.P.M. Special features eliminate effect of spindle overhang on accuracy.

DIXI 450 PRECISION OPTICAL CIRCULAR DIVIDING TABLE

Direct readings of 1 sec.

(See insert picture above) rigidly mounted (not tilting) on built-in rotary table permits holding close tolerance relations between bores in all planes, including bores at compound angles. ALL IN ONE SET-UP. All sides of the work piece except the mounting face machined in one set-up.



- · Guaranteed service by factory trained staff
- · Engineering staff available for consultation
- Spare Parts in New York stock
- Your operators trained

DIXI 60 now in wide use in leading Aircraft and Manufacturing Plants throughout the United States. Names available upon request.

SEE THIS **VERSATILE MACHINE** IN OPERATION

at our New York or Cleveland Show Rooms. Write for Complete descriptive literature and prices to Department 21. Catalogues on additional production equipment also available on request.



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A Division of Machinery Builders, Inc.

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Over 20 years experience in designing & building machinery

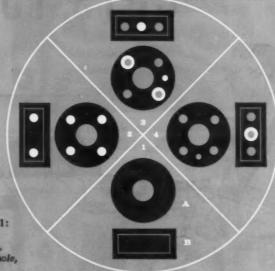
Phone MOtt Haven 5-0900

Natco Naturals

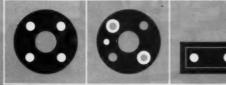
Cost-Cutting Ways
You Can Use
Standard Multi-Spindle Natcos

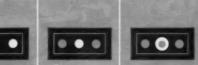
Any time your parts require machining more than one hole—drill, bore, face or tap—it may well be a "Natco Natural." Your standard Natco will produce substantial savings in a surprising number of situations, even in small job-shop lots! Call in your nearby Natco field engineer; he'll tell you in short order whether you've got a "Natco Natural" there.

Multiple Drilling Operations on Two Part-faces

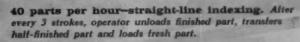


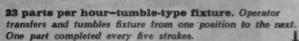
130 parts per hour-4-position rotary table. Position #1: Unload finished part, transfer half-finished part, load new part. Position #2: Drill 4 holes, Face A. Drill and countersink 2 holes, Face B. Position #3: Drill 1 hole, ream 2 holes, Face A. Drill 1 hole, Face B. Position #4: Trepan 1 hole, Face B.

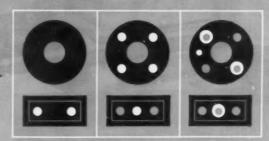


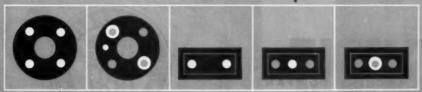


65 parts per hour-stationary fixture with 5 work locations. Operator transfers parts after each stroke. One part completed per stroke.









Standard multi-spindle Natcos range from 1 hp, 10-spindle machines to 50 hp machines with up to 72 spindles. Spindles in standard Natcos are driven through universal joints and located by either adjustable arms of bored slip plates.



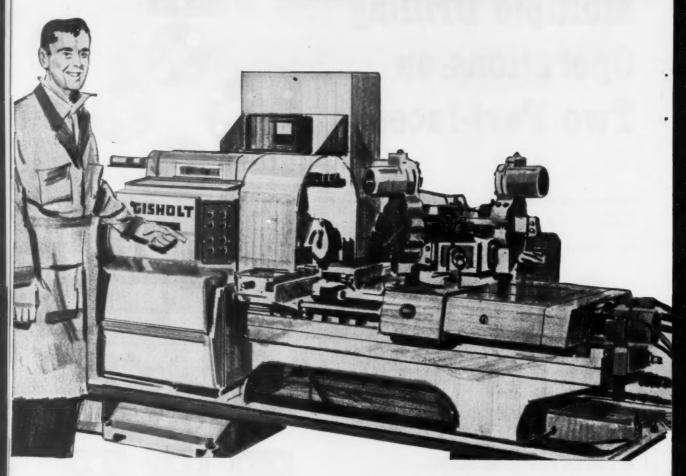
National Automatic Tool Company, Inc.

Richmond, Indiana

Multi-spindle drilling, boring, facing & tapping machines. Special machines for automatic production.

Call Natco Offices in Chicago, Detroit, New York, Buffalo, Boston, Philadelphia, Cleveland, Los Angeles; distributors in other cities.

NEW Gisholt Fastermatic CUTS YOUR SETUP TIME



GSHOLTPANY



TURRET LATHES . AUTOMATIC LATHES . SUPERFINISHERS . BALANCERS . PACKAGING MACHINES . MOLDED FIBERGLAS PLASTICS

control panel

50% OR MORE

BY SIMPLY FLIPPING TOGGLE SWITCHES, your operators can cut automatic turret lathe setup time $50\,\%$ or more with this electric setup control panel.

Thoroughly proved in production lines, this control panel is one of the many advanced features available on the new Gisholt MASTERLINE Fastermatic Automatic Turret Lathe.

Here's how the panel works: within finger-tip reach, your operator has a horizontal row of toggle switches for each face of the hexagon turret. By simply flipping the switches right or left, he pre-selects desired machine functions. Re-runs? Here the Fastermatic makes even more drastic cuts in setup time. A master reference card, made from the previous run, is used, and the machine is ready to go with absolute minimum preparation. Feed changes are fast and easy. Tool overhang is quickly minimized by re-positioning the saddle. Anywhere within the machine cycle, the operator can make a trial cut, withdraw the tools, mike the part, re-set the tools and resume forward feed.

What does this versatility mean to your own operations? It means more time spent cutting chips and more profit per piece. It means that less skill is required of the operator and he is free to handle additional units or do other work during machining cycles. It means you can utilize smart tooling and eliminate human errors...get record production on long runs ...and also get the advantages of automatic cycle operation on relatively short runs.

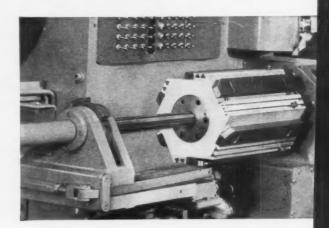
Ask your Gisholt Representative to tell you about the Fastermatic's new electric control panel...its increased capacity...its higher speeds and feeds and heavier construction. You'll also want to know about using the Gisholt JETracer on the Fastermatic. Call him today—or write Gisholt for literature...ask for Bulletin No. 1179.



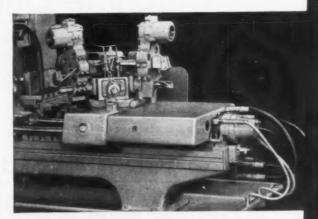
GISHOLT JETracer—mounts on any one of Fastermatic's turret stations. Provides exceptional accuracy for turning, boring or facing—either straight, taper or contour. Hydraulically operated; stylus follows contour of template controlling movement of single-point tool on sliding member.



NEW GISHOLT FASTERMATIC CONTROL PANEL—simple toggle switches govern basic machine functions, cutting initial setup time in half. Master reference card is used to cut setup time still more on re-runs.



HEXAGON FEED CONTROL DRUM—positioning of adjustable flat bars on each face determines rate of feed. Thumbscrew actuator pins in slots on each face determine point of change from traverse to feed and length of feed.



FASTERMATIC TURRET SADDLE is hydraulically powered for indexing and longitudinal movement. Automatic cycle easily set up with turret double- or triple-tooled. CROSS SLIDES—front and rear—operated by forward movement of turret saddle, can work independently, or together, with any turret face.

no wonder this shop is 100%



Machine Utilization

The result of extreme machine rigidity which maintains precise tool settings throughout the run... keeps down-time to an absolute minimum (in this case an average of only 16 minutes per machine per shift).

98%

Cycle Efficiency

Made possible by Acme-Gridley Controlled Cycle operation, which assures a steady, predetermined production pace.

75%

Acme-Gridley"



"We call 'em workhorses" says Mr. Bob Barnd, Factory Manager of Eaton Screw Products Plant, Tube & Hose Fittings Division of the Parker Appliance Co., describing the Acme-Gridley Bar Automatics and Chuckers in this 100% Acme-Gridley equipped Eaton Ohio plant.

Carefully kept records certainly prove these Acme-Gridleys can take it. They are operated two 8-hour shifts a day, five days a week—with a utilization factor of 98%, combined with a cycle efficiency of 75%. In a period of one month, they produce well over two million hydraulic tube and hose fittings. "The machines themselves," says Mr. Barnd, "are largely re-

sponsible for our low down-time. Once setup, they are rigid enough to maintain the most precise setting, shift after shift."

This is typical of Acme-Gridley performance all over the world. It is the end result of two important Acme-Gridley basic design features: (1) controlled cycle time, which maintains a steady, hour-after-hour, predetermined production pace; and (2) extreme machine rigidity, that comes from being built with an ample reserve of beef, properly distributed, for an extra margin of assurance to-day—and for any additional burden tomorrow's tooling requirements may place upon them.

why don't you

INDEX... to lower

machining costs...

With Acmo Gridley

CONTROLLED CYCLE

WHY don't you

THE NATIONAL ACME CO.

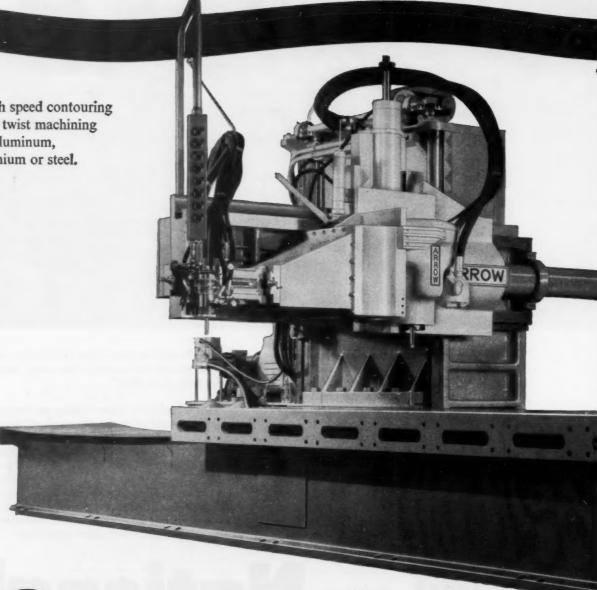
179 EAST 131ST STREET

CLEVELAND 8, ONIO

Announcing the

ARROW PROFILER

High speed contouring and twist machining in aluminum, titanium or steel.



ARROW ENGINEERING COMPANY, INC., 120 East Market Street, Indianapolis, Indiana



The Arrow Profiler—capable of any 360° profiling, 3-dimensional contouring, swarf or twist machining. Simple to operate, highly accurate and versatile—at lower cost than other machines capable of the same work.

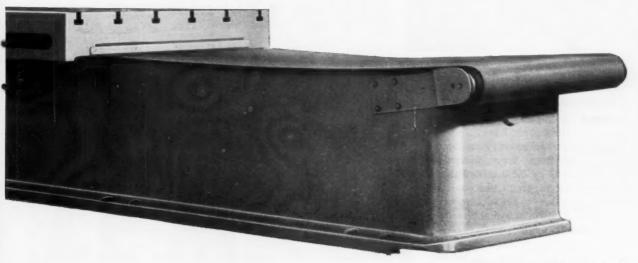
Sturdily constructed and equipped with a 20 HP hydraulic powered spindle, the Arrow Profiler has the rigidity, power and and speed range for high production machining of steel and titanium as well as aluminum. Speed changes (from 37—3000 RPM) are made through pick-off gears for high torque at low speeds (30,000 in/lbs. at 37 RPM).

Manually operated hydraulic tracing valve assures machining accuracy within $\pm .005$. Manual operation also allows operators to push Profiler to maximum production at all times.

The Profiler table has large capacity—42" x 144". It is hydraulically driven, has 136" travel, and runs on normalized cast iron V-bedway. Table feed is 0-40 ipm with rapid traverse of 100 ipm.

For swarf or twist machining, a second tracing valve is installed and the spindle is mounted on an arc-shaped way. A swarf of over 20° either side of centerline can be machined.

Write for Bulletin PR-156. Get full information on this low cost answer to your contouring, pocketing and swarfing problems.



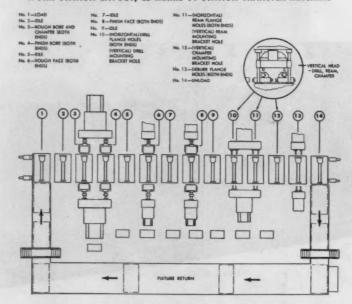
MACHINERY, July, 1957-41



Huge Half-ton Fixtures Automatically Returned under "Fingertip Control"

Finished parts are automatically unclamped at the unload station. Empty fixtures are then transferred by the LeMaire shuttle bar conveyor to the long return conveyor, which returns them to the loading end at high speed. A system of hydraulic decelerating valves maintains perfect control during completely automatic handling of these 21 huge, 1,150 pound fixtures.

WORK STATION LAYOUT, LE MAIRE 14-STATION TRANSFER MACHINE



TOTAL MACHINING OPERATIONS-17



MACHINES 128 TORQUE TUBES PER HOUR

This is one of five similar LeMaire transfer machines in a single large automotive installation. It completely machines 128 torque tubes per hour, and is designed to process two parts of different length with a minimum of changeover time.

Work is loaded manually into fixtures, then clamped automatically by two equalizing chuck jaws which are actuated by hydraulic power wrenches. As fixtures move through the machine they are located at each station by shot bolts which enter bushings in the fixture bottom. Fixtures are automatically clamped on hardened rest plates. Plugging bars in the work heads move in and locate in the fixture, to further assure positive alignment.

Machine features include: Unitized construction . . . idle stations allow ample room between work stations,

making all machine locations conveniently accessible

LeMaire precision hydraulic work heads

LeMaire fast-acting, adjustable hydraulic torque wrenches

Antifriction tool holders

Tapered roller bearings in boring and facing heads

Complete electrical interlock

Individual push buttons at each station to simplify setups

"PresTest" lights on main push button station

All electrical and hydraulic equipment to J.I.C. standards

Patented LeMaire test panel on all control cabinets

Self-contained chip conveyor and chip flushing and

tool coolant systems.

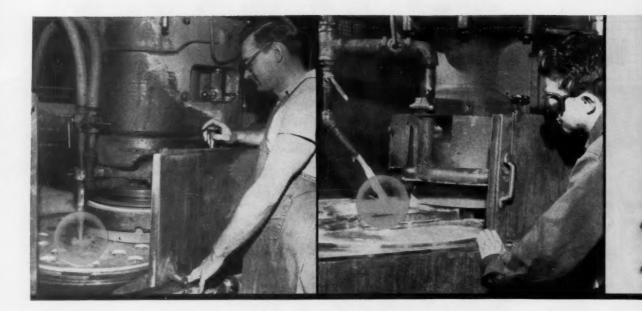
Check LeMaire's background of successful, producing installations... then let us help solve your production problem. Take the first step now... send parts or prints for prompt recommendations.

LE MAIRE

TOOL AND
MANUFACTURING

2657 SOUTH TELEGRAPH ROAD . DEARBORN, MICHIGAN

Designers and Builders of Special High-Production Machines



When you surface grind with segments

Take advantage of this COMPLETE Line

... and add the profit-boosting "Touch of Gold" to any surface grinder

You can be sure that switching from grinding wheels to Norton abrasive segments brings powerful, profitbuilding "Touch of Gold" benefits to very many jobs.

Because -

Norton makes segments in every required shape and size and in exactly the right abrasive and bond for best results in the widest variety of surface grinding — on ferrous and non-ferrous metals and on work pieces ranging from boiler plate to the hardest die steels, die sets or blocks.

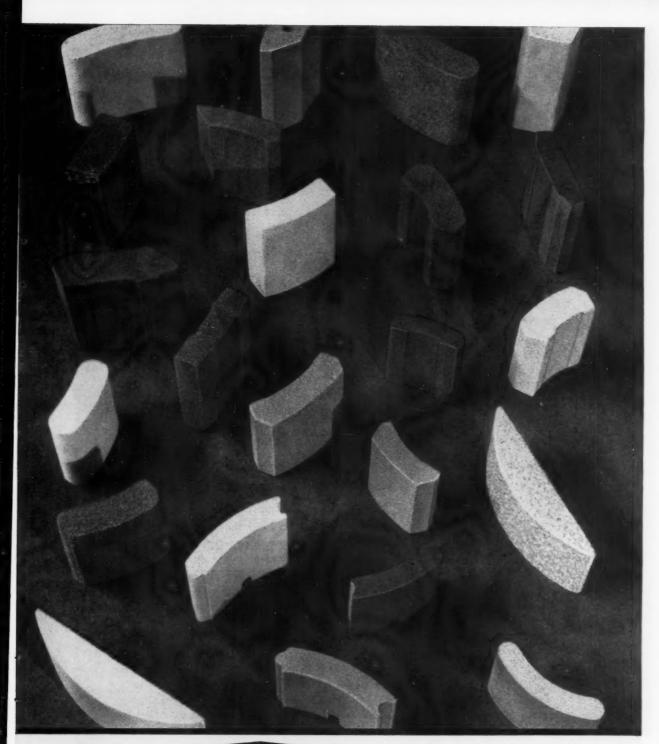
Norton segments are made in many ALUNDUM* abrasives. Of these, 32 ALUNDUM abrasive is particularly suited for fast stock removal and heavy feeds. 37C CRYSTOLON* abrasive, unequalled on hard cast iron and soft nonferrous metals, is also available. And diamond segments are also furnished, if desired, for ceramics, quartz and glass.

Bonds include the G and BE — both vitrified — as well as resinoid bonds. Structure can be either regular or the open (induced pore) which is especially advantageous for many jobs. In the field of surface grinding, users have reported that the G Bond — most efficient vitrified bond ever developed — results in new speed and economy.

With this broad range of abrasives and bonds to choose from you can count on much faster production rate at considerably lower costs. And when you mount these cost-cutting segments in Norton chucks — designed to fit several machines — you safeguard performance and profits.

Ask Your Norton Distributor for the booklet, "The A.B.C. of Surface Grinding." Or write to Norton Company, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries





Making better products . . . to make your products better

NORTON PRODUCTS

Abrasives • Grinding Wheels
Grinding Machines • Refractories

BEHR-MANNING DIVISION

Coated Abrasives • Sharpening Stones Behr-cat Tapes

OSBORN BRUSHING METHODS worthy of your confidence



Push-button finish... 1400 per hour

THE manufacturer of this machined aluminum ammunition component was faced with the necessity for attaining a high production rate, and at the same time, meeting the standards of rigid quality control.

Working closely with the Osborn representative, he built the rotating fixture shown above. Three Osborn Master. Wheels quickly remove feather burrs, blend surface junctures. Uniformly finished parts come through at the rate of 1400 per hour.

Osborn offers its services to you without obligation. A qualified Osborn Brushing Analyst is available wherever industry centers. He will welcome the opportunity to work with you. Write The Osborn Manufacturing Company, Dept. D-36, 5401 Hamilton Avenue, Cleveland 14, Ohio.

Write TODAY for the new 100-page Osborn Catalog 210-C. Osborn Brushes

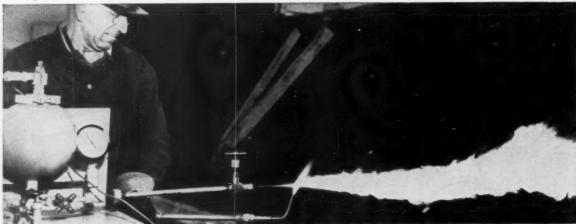
BRUSHING METHODS • POWER, PAINT AND MAINTENANCE BRUSHES • BRUSHING MACHINES • FOUNDRY MOLDING MACHINES

46-MACHINERY, July, 1957



BUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.



Mineral oil hydraulic fluid instantly ignites upon torch flame contact

Fire resistance plus low cost

FOR MANY YEARS frequent industrial fires involving hydraulic fluids have taken their toll in man-hours and high costs. This has created a widespread need for a relatively inexpensive all-purpose, fire-resistant hydraulic fluid.

In undertaking this challenge, Shell Research Laboratories spent over four years in laboratory and field testing before a solution was reached. The result was the introduction of Irus* Fluid 902 . . . the first low-cost, oil-base fluid that, under plant conditions, actually snuffs out fire.

The new formulation is a specific combination of petroleum oils mixed with water and emulsifying agents. It gains its fire resistance through a relatively high water content. Irus Fluid is perfectly adapted to the majority of hydraulic systems. The following is typical of many reports in Shell files.

Typical Problem and Solution

The welding plant of a prominent automotive manufacturer employing 100 hydraulically operated electric

welders formerly used a straight mineral oil fluid. On one occasion, damaged fluid lines allowed this mineral oil under high pressure to spray directly onto the welding area. Sparks ignited the fluid... caused an immediate flash fire which resulted in 75% machinery damage before it was extinguished. Immediately following this incident, the changeover was made to Shell Irus Fluid 902. Shortly thereafter a line broke and the high-pressure spray once more contacted welding sparks. There was no fire at all... and in a matter of minutes the machinery was operating at full efficiency.

The two photos above provide dramatic proof of its flame resistance. In the photo on the left, conventional hydraulic fluid instantly ignites upon contact with an oxy-acetylene torch flame, whereas Shell Irus Fluid 902 (right photo), under the same conditions, does not support combustion beyond an inch or two from the flame. Under plant conditions, it actually snuffs out fire!

Two-Way Economy

An advantage not to be overlooked is the low cost of Irus Fluid 902. Many plant operators now making the



A leak is quickly spotted because of Irus Fluid's distinctive vellow color.



The complexity of cable lines necessitates the use of a fireresistant hydraulic fluid to eliminate fire hazard,



Under the same conditions, Shell Irus Fluid 902 clearly demonstrates its fire resistance

in a new hydraulic fluid

switch to Irus Fluid find that it costs up to one-third less than other fire-resistant fluids—and its performance is comparable in every practical respect. This money-saving advantage is a vital consideration not only in the initial purchase price, but in reducing make-up loss expense.

Irus Fluid 902 has other features, too:

- It contains no corrosive ingredients and has shown no harmful effects on normal seals, fittings, or bearings...it will not promote rust.
- No major equipment modification is necessary... simply clean your present fluid thoroughly from the system and replace with Irus Fluid.
- 3. Practical application proves it has exceptional viscosity and lubricating qualities . . . doesn't thin out in use.
- 4. The yellow color of Irus Fluid enables you to spot and trace leaks easily . . . a valuable benefit in preventive maintenance.

If your operation utilizes die-casting machines, plastic molding machines, glass blowing machines, permanent mold machines or any other hydraulic equipment where fire hazards are of concern, we suggest you investigate the advantages of Shell Irus Fluid 902.

Write or call the Shell Oil Company office nearest you.



Such specialized die-casting machines require a fireresistant hydraulic fluid to assure maximum safety.

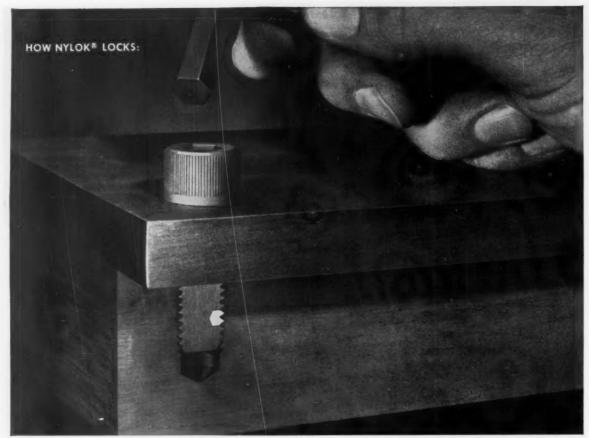


Finger points to line break in hydraulic cable that caused flash fire and machinery damage while operating with mineral oil type fluid.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK 100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA





LOCKED! The tough, resilient nylon pellet keys itself into the mating threads. It forces threads together and locks the screw securely.

NEW—self-locking UNBRAKO socket head cap screws



Self-locking UNBRAKO socket head cap screw.

They won't work loose. And they simplify design and save production time.

UNBRAKO socket head cap screws are now available embodying the Nylok* self-locking principle. Nylok provides the first truly practical solution to the problem of making cap screws self-locking.

An Unbrako cap screw with Nylok is a single self-locking unit. No auxiliary locking devices are needed. Just thread the Unbrako into any tapped hole. Seated or not, it locks positively wherever wrenching stops. The tough, resilient nylon pellet forces mating threads together and holds tight. The screw will not work loose.

You save production time when you make products with self-locking UNBRAKOS. And you get greater simplicity in design with less bulk and weight. The number of parts you must assemble to achieve full locking action is reduced to the absolute minimum. Lockwashers under screw heads are no longer necessary. Costly wiring of cross drilled heads is eliminated. And in many

cases you will save weight and mass by using shorter screws in tapped holes instead of drilling through and using nuts and lockwashers.

Self-locking Unbrakos are reusable. They have uniform locking and installation torques—with no galling or seizing on mating threads. They successfully withstand temperatures from -70° to 250° F. And, when screws are properly seated, the locking pellet also functions as a liquid seal.

A complete line of self-locking Unbrako socket screw products, in a wide range of standard sizes, materials and finishes, is available through your authorized industrial distributor. Technical data and specifications are detailed in Bulletin 2193. Write us for your copy today. Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 19, Pa.

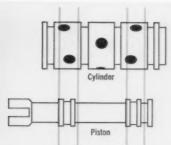
*T.M. Reg. U.S. Pat. Off., The Nylok Corporation

UNBRAKO SOCKET SCREW DIVISION

SPS JENKINTOWN PENNSYLVANIA

STANDARD PRESSED STEEL CO.

MATCH PISTON LANDS TO CYLINDER PORTS PRECISELY WITH SHEFFIELD'S MICRO-FORM GRINDER



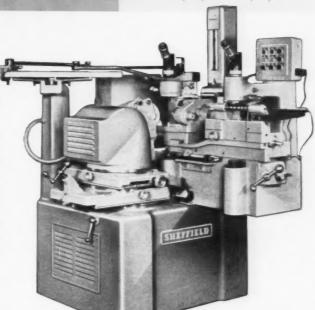
This servo cylinder and piston are typical of the very precisely machined hydraulic components in aircraft propeller and flight control systems.

With the actual cylinder as a reference, each piston land is individually ground to match the inside edge of its respective cylinder port.

If a flow test then reveals the slightest discrepancy between land and port edge, the piston is given a finishing touch, using a Sheffield Precisionaire and Airetest Indicator to show progress in stock removal. Thus, the correction of the land face can be accomplished to within \pm .000010".

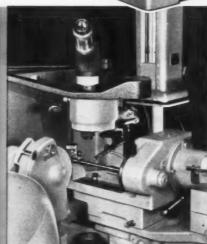
This is typical of the wide range of Micro-Form Grinder applications in duplicating precision profiles or reverse profiles from a master. Write for Bulletin MFG-121-C to Dept. 9.

THE SHEFFIELD CORPORATION, DAYTON 1, OHIO, U.S.A.





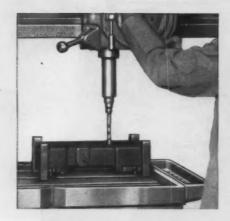
Cylinder under observation on auxiliary table.



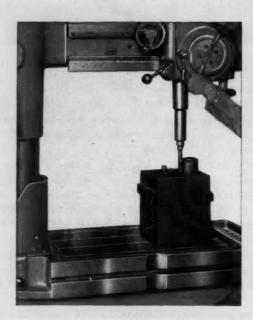
Airetest Indicator shows stock removal in final correction.

the SHEFFIELD corporation

7560



SMALL WORK



BIGGER...

FOSDICK SENSITIVE RADIAL DRILLS

sensitive to your

We put a table on the radial to give you two machines in one—and a work size versatility that is unmatched in any drilling machine of comparable price and size!

Actually, the Fosdick Sensitive Radial combines the best features of two proven, reliable designs. The capacity and flexibility of a radial—the rigidity, compactness and convenience of an upright. For job shop work or production, it's the answer to useful capacity in limited floor space. Economically priced, too! The economy of first cost is second only to the economy of use.



STILL BIGGER



ALL THESE WORK SIZES ON ONE MACHINE— The Fosdick Sensitive Radial Drill. Also available as a Layout Machine, which combines high precision compound table with sensitive radial drill.

work size problem...and your pocketbook

The arm of the Sensitive Radial swings 360° on the rigid one-piece column. Controls are always at the same convenient height. Work is placed on the adjustable table, or on the base with the table swung out of the way. Drills up to 2" in cast iron. 12" column, 3' or 4' arm, nine speeds (ranges from 60-1200 to 175-3500 rpm), four feeds (.004-.020 or .002-.010), 3 hp motor, reversing motor control for tapping.

Write today for complete information on the Fosdick Sensitive Radial Drill.

Ask for Bulletins SRA and LMA.

NEED DRILLING EQUIPMENT?
GET A PROPOSAL FROM FOSDICK!

Formatic Radau Drils
Bigs Sensitive and Bigs Sensitive and

For men who know Drill Heads Best... it's always

UNIVERSAL JOINT



FIXED CENTER OIL CIRCULATING



FIXED CENTER GREASE LUBRICATED



RADIAL SWIVEL ATTACHMENT WITH AIR COUNTERBALANCE



TURRET LATHE TYPE



INDIVIDUAL LEAD SCREW TAPPER



STANDARD **ADJUSTABLE**



BURNS STREET . CINCINNATI 4, OHIO

54-Machinery, July, 1957

For more information fill in page number on Inquiry Card, on page 259



Unitool*... a fast, easy, low-cost way to produce prototype bevel gears!

Now you can produce small quantities of spiral bevel, Zerol® bevel and hypoid gears with a comparatively small capital outlay and without specially trained personnel

You can reduce the time and expense it takes to change your angular drive from a drawing board idea to a working model, too, because the Unitool Method produces good quality gears directly from the initial calculations.

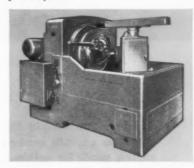
The Unitool Method is based on a fundamentally different theoretical approach to bevel gear generation. Only six different cutters are required to cut gears up to 14" pitch diameter—spiral bevel and Zerol bevel pairs of any ratio; hypoid pairs 3:1 ratio and higher. Because these cutters have a wide overlap in range, cutter diameter is not critical.

Calculations are short enough and easy enough for you to do in your own plant. Correct tooth thickness and position of contact are easily determined without requiring special operator training.

The Unitool Method is designed especially for the Gleason No. 106 and No. 116 Hypoid Generators which feature increased universal cutter tilt.

*Trademark

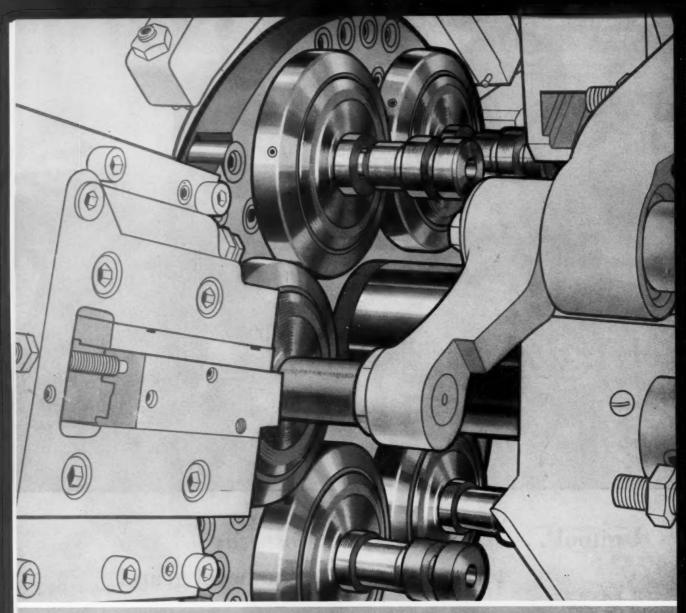
We will be glad to send further information on the Unitool Method and the two Gleason Generators best suited for it at your request.



The Gleason No. 106 Hypoid Generator is a high-speed machine for spiral bevel, Zerol bevel and hypoid gears up to 8½" pitch diameter. Its larger counterpart, the No. 116 Hypoid Generator, handles the same type gears up to 18" pitch diameter.



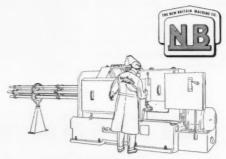
Builders of bevel gear machinery for over 90 years
UNIVERSITY AVE., ROCHESTER 3, N. Y.



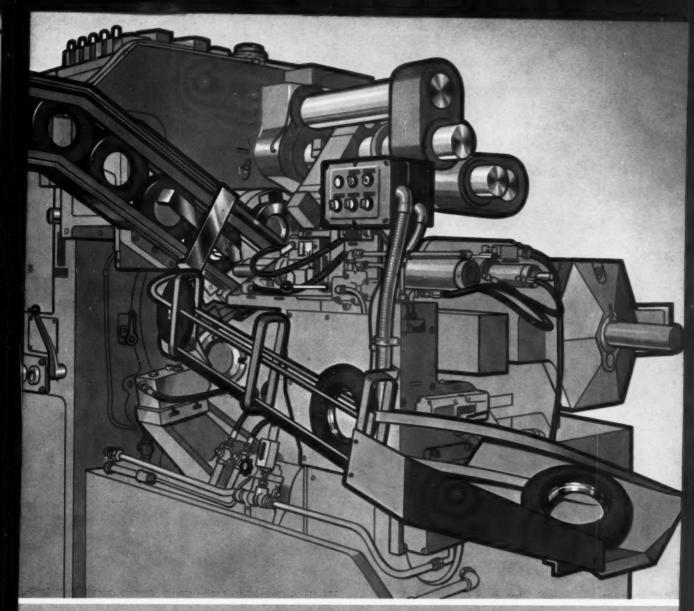
get more bar work done with the

widest range of spindle speeds

The New Britain Model 62, 21/4" automatic bar machine illustrated, has a spindle speed range of 117-3,000 R.P.M. No other multiple spindle bar machine in its capacity offers as wide a range of spindle speeds combined with New Britain standards of accuracy. Before you decide on any bar machine, be sure to check on new developments in New Britains. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



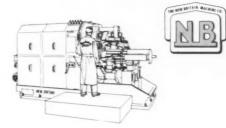
Automatic Bar Machine



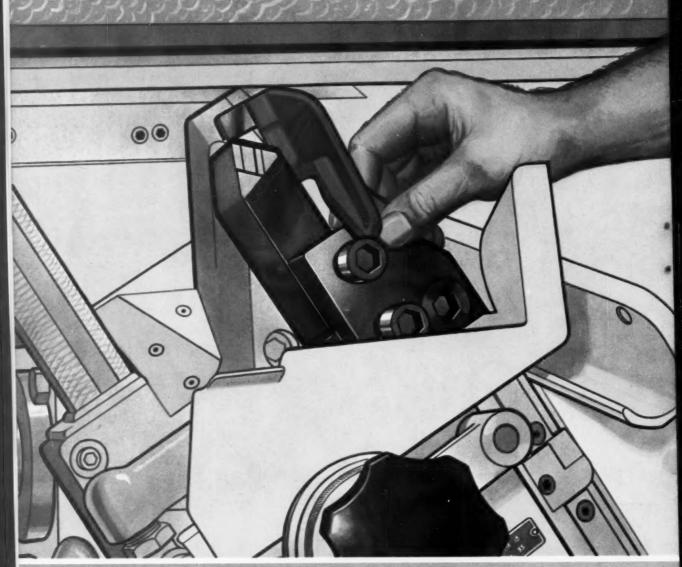
get more chucker work done

with automatic "handling"

New Britain chuckers are the time-tested leaders in their field. Their basic open-end design, an exclusive New Britain feature, makes them unusually well adapted to the automatic handling of pieces. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



Automatic Chucking Machine



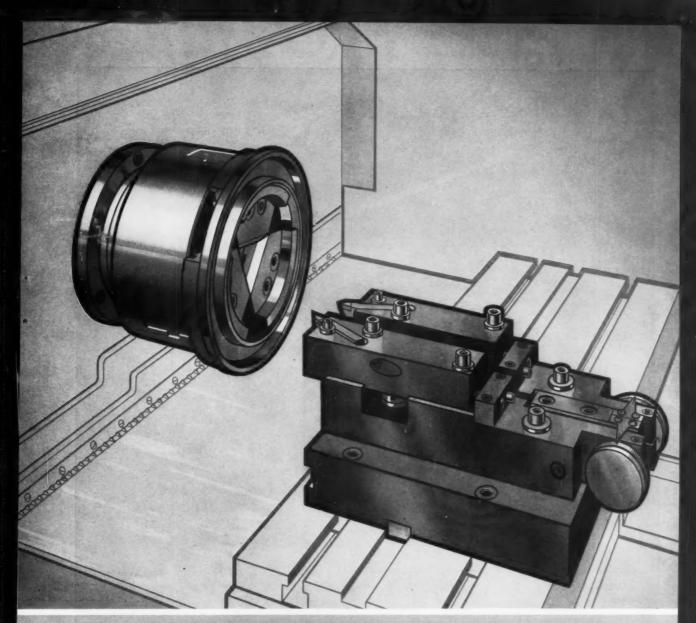
1-minute tool change gets more

contour work done

It's a fact — you can do more work in a day with a New Britain +6F+ copying lathe and a single-point tool, than with a conventional lathe using half a dozen. Just slip out the worn tool, slip in a new one, gauge it to a single dimension and you're ready to go again. The template repeats the dimensions. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



New Britain +GF+Copying Lathe



closer tolerances because of cam control in New Britain precision boring machines

Every piece turned out by a New Britain Precision Boring Machine is accurate in every dimension because of the precision cams which control the slides. Tool wear can be checked by gauging a single dimension per tool of even the most complex contoured piece. There's no substitute for this positive uncomplicated dimensional control when you're working to "tenths." The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



Precision Boring Machine



Vibration won't loosen FLEXLOC self-locking nuts

Where products must be reliable...must stand up under vibration, temperature extremes and hard use ... designers specify rugged, reliable, precision-built FLEXLOC self-locking nuts.

HERE'S WHY:

FLEXLOC locknuts are strong: tensile strengths far exceed accepted standards. They are uniform: carefully manufactured to assure accurate, lasting locking action. And they are reusable: repeated removal and

replacement, frequent adjustments, even rough screw threads will not affect their locking life.

Standard Flexloc self-locking locknuts are available in a wide range of standard sizes, types and materials to meet the most critical locknut requirements. Your local industrial distributor stocks them. Write us for complete catalog and technical data. Flexloc Locknut Division, STANDARD PRESSED STEEL Co., Jenkintown 19, Pa.

STANDARD PRESSED STEEL CO.

FLEXLOC LOCKNUT DIVISION



720 Assemblies Per Hour AUTOMATICALLY!

This Robbins "Assemblimatic" feeds, positions, assembles and unloads automatically . . . producing 720 four-piece assemblies every hour! It assembles a needle bearing, washer and seal in two sizes of a steering gear end cover. Parts are fed and positioned from indexing magazines, and completed assemblies are removed and placed on a conveyor . . . all automatically.

Machine features include: (1) Robbins panel, one-third standard size, with plug-in aircraft type relays and controls which prevent assembly unless parts are correctly positioned, (2) Index table with both barrel type cam and shot bolt for accuracy and magnetic oper-

ation of index and dwell, (3) Positive dwell time control through synchronous timer and electrical interlock at each station, (4) Hardened and ground ways, (5) Automatic lubrication, (6) Electrical and pneumatic equipment to J.I.C.

Robbins special assembly machines save manpower, speed production and improve quality, often combine machining with assembly for further savings. Automatic inspection, selection, orientation, assembly and in-process gaging assure consistent high quality production. Ask us for recommendations to help solve your automatic assembly or machining problem.

OMER E. ROBBINS COMPANY 24796 PLYMOUTH ROAD . DETROIT 39, MICH.



SPECIAL MACHINES

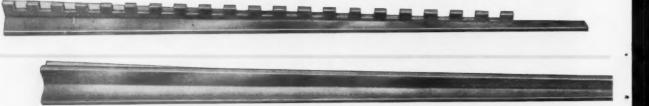


New brochure describes and illustrates a variety of Robbins special assembly machines. Write for your copy.

LOOKING FOR FAST PRODUCTION?

there's no faster way to machine

than by LAPOINTE



With increasing emphasis being placed on higher net production, you may be interested to realize that you can broach 20 slots (5%" x 5%") in an aluminum missile fin spar four feet long, and produce 64 completely broached parts per bour (at 80% efficiency)!

The secret's in "gang-broaching", with eight broaches mounted on an 18-inch wide slide, and using a lateral type indexing table with all sequences fully automatic throughout. Lapointe-built fixtures are hydraulically operated, mounted on an In-and-Out table.

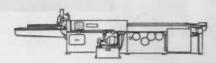
Some of the metal-removing operations in your shop probably can be performed faster and better by Lapointe-Broaching. It certainly would be to your advantage to find out . . . and an experienced Lapointe Field Engineer will gladly discuss the matter with you on request. How about writing us, today?

THE LAPOINTE MACHINE TOOL COMPANY

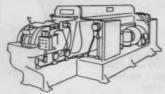
HUDSON, MASSACHUSETTS . U.S.A. In England: Watford, Hertfordshire

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES

Here's a line of ELECTRO-MOTIVE DRIVE BROACHING MACHINES available only at LAPOINTE



60" STROKE HORIZONTAL, ELECTRIC



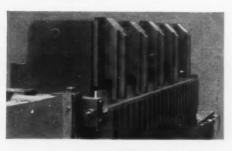
CH CONTINUOUS BROACHING, ELECTRIC



SRHE SINGLE RAM HORIZONTAL, ELECTRIC

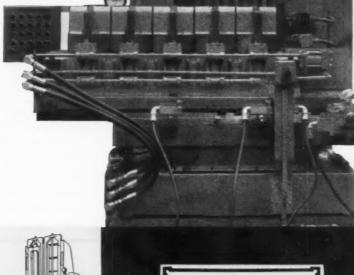
1280 slots per hour

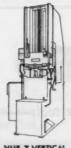
-BROACHING!



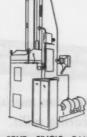
Rear view of fixture,

showing the efficient clamping unit.
Broaching at 60 feet-per-minute, one pass of ram broaches 8 slots, two more passes completing the broaching of the part.
The machine is the 10-ton, 48-inch stroke Single Ram Vertical Lapointe Broaching Machine which is one of the SRV series ranging from 3- to 25-ton capacity, 30- to 90-inch stroke.





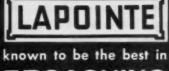
VUE-7 VERTICAL PULL-UP ELECTRIC



SRVE SINGLE RAN VERTICAL ELECTRIC



DRVE DOUBLE RAM VERTICAL ELECTRIC



BROACHING

UNIVERSAL THREAD and WORM GRINDERS

For Production or Tool Room Grinding Operations

The Type NRK
UNIVERSAL Thread
and Worm Grinder
is designed for grinding
with single or multithread wheels. This
machine, with
attachments, can be
used for grinding
and relief-grinding
of external—rightand left-hand—
single or multiple screw
threads—to any
desired profile.



THE NRK GRINDS:

- Thread Gauges
- Taps all kinds straight or spiral flutes
- Thread Milling Cutters
- Trapezoidal Thread Spindles
- Thread Chaser Dies for self-opening die heads
- Gear and Worm Hobs
- Cylindrical Press Rollers
- Thread Rolling Dies up to 8" diameter
- Crushers for forming multi-rip grinding wheels
- Commercial Threads —
 plunge cut method on all kinds
 of screws, studs, spindles, etc.
- Internal Threads up to 5" diameter
- Racks up to 18" long

CAPACITY AND SPEEDS

Admits work pieces between centers	28"
Maximum length of thread ground	17-1/2"
Minimum thread diameter	
Maximum thread diameter	8"
Minimum pitch	60 t.p.i.
Maximum pitch	3"
Width of single thread grinding wheel	
Widths of multi-thread grinding wheel	
Speeds of grinding wheel	1550 or 1900 r.p.m.
Speeds of work spindle	1.6 to 80 r.p.m.

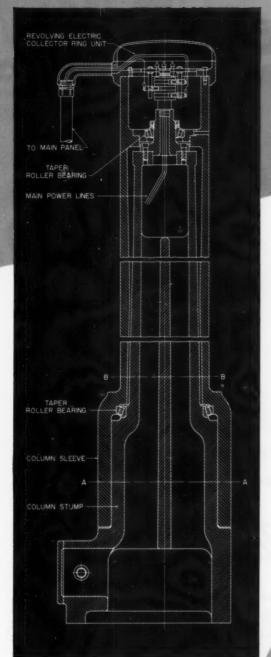


COSA

nationwide sales and service of precision machine tools—
 —from bench lathes to boring mills.

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

IN CANADA Contact COSA CORPORATION of CANADA, Ltd., 1160 Lakeshore Road, Long Branch, Toronto 14, Ontario



New thrust resistant, "TIMKEN" mounted column and sleeve assembly.

Write for Bulletin No. 328 for the complete story of More and Better Work at Lower Cost.

Rigidity Increased

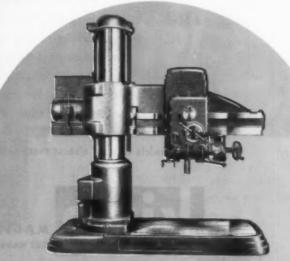
50%

The new "TIMKEN" mounting of the column and sleeve on the new model 32-speed Hole Wizard Radial has hit the "jack-pot" for rigidity. It's the stiffest, most resistant column unit we've ever known.

Under drilling tests up to 30 horse power deflection has been cut in half over former models. It's truly a marvel of rigidity.

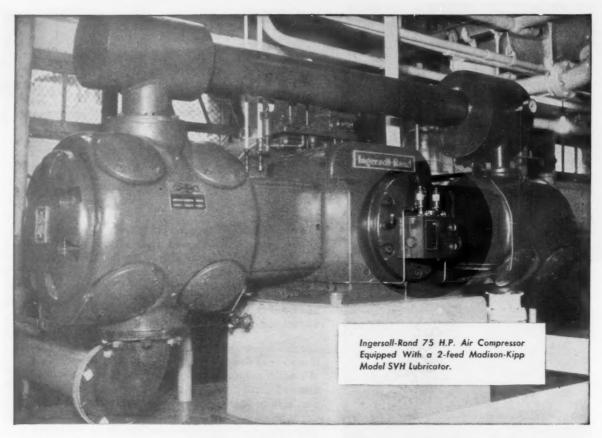
Large Timken bearings at top and bottom when preloaded bind the column and sleeve into the equivalent of a solid unit for resisting functional stresses and cuts arm deflection to an absolute minimum. This definitely results in greater accuracy and longer cutting tool life. To further increase resistance to stresses the column sleeve departs from conventional design by employing a tapered inner wall providing an unusually heavy section where the greatest functional stresses are concentrated.

A new "NON-CREEP" clamping mechanism in combination with a solid column sleeve cuff adds greatly to the rigidity of this new "AMERICAN" Radial.



THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U.S.A.

LATHES AND RADIAL DRILLS



Machines of great performance use the most dependable oiling system ever developed MADISON-KIPP

.. by the measured drop,

from a Madison-Kipp Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's finest machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy, where oil under pressure fed drop by drop can be installed. There are 6 models to meet almost every installation requirement.



MADISON-KIPP CORPORATION

- Skilled in Die Casting Mechanics

 Experienced in Lubrication Engineering

 Originators of Really High Speed Air Tools

Reduces Machining Time

BULLARD

Cut Master VERTICAL TURRET LATHE

In the machining of a barrel housing used in a large mechanical press, manufactured by the Clearing Machine Co., Chicago, Ill., Mr. L. W. Prochnow, Factory Manager says "our 66" Cut Master, Model 75 is a big, husky machine. Its heavier rams, overall rugged construction and greater horsepower provide higher speeds and feeds easily controlled from the movable Pendant. These features enable us to cut our floor to floor time, per piece, by four hours. And we've had no maintenance problems in nearly two years of operation.' These same cost savings can be applied to your machining problems when considering replacement or additional capacity in your plant.

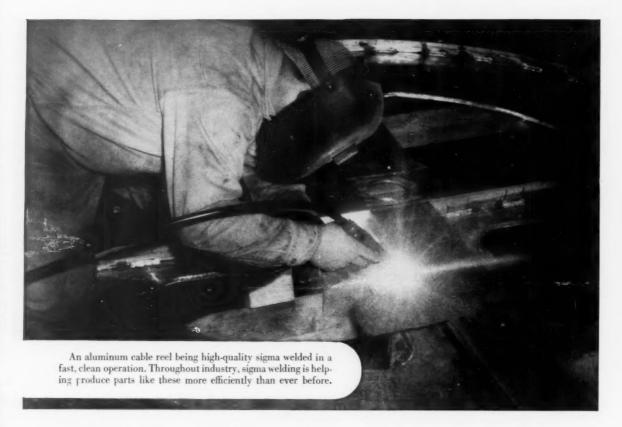
From rough casting, weighing 1,780 lbs., 28" in diameter and 36" long, to finished piece with a 35% saving in machining time



to cut costs
when cutting metals buy BULLARD

Our nearest Sales Office or Distributor will be glad to show you how or write for complete catalog to

THE BULLARD COMPANY
BRIDGEPORT 9, CONNECTICUT



SAVED-50% of fabricating cost...

by using

SIGMA WELDING

Sigma welding's combination of automatic wire feed, and dependable argon gas-shielding accounts for the fifty per cent cost saving made in fabricating aluminum cable reels like the one shown above. Top quality welds are made in these 1/4 and 1/2 inch thick aluminum parts at speeds up to 20 inches per minute-and no post weld treatment is necessary.

The Ease of Handling gained by automatic wire feed both simplifies and speeds welding operations. A shield of inert argon gas envelopes and protects the weld puddle from harmful effects of the atmosphere, and eliminates need for flux.

Sigma Welding Is Ideal for a Wide Range of Jobs because it joins all commercially fabricated metals, and can attain full penetration up to ¼ inch in a single pass. A complete line of portable manual, and automatic mechanized apparatus is available-and all are easy to operate and maintain.

For more information on sigma welding, or on any of LINDE's modern methods of joining metals, call your local LINDE representative—or write for free illustrated literature. Start saving now, do it today.

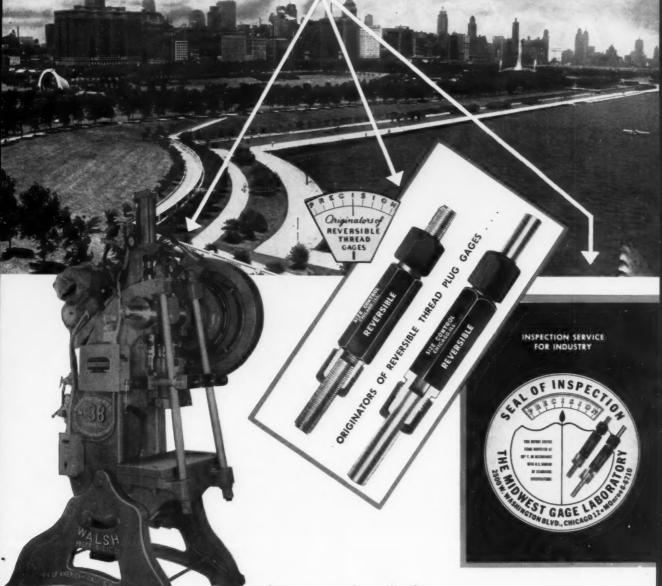
Division of Union Carbide Corporation 30 East 42nd Street, New York 17, New York Offices in Other Principal Cities



In Canada: Linde Company, Division of Union Carbide Canada Limited. The terms "Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

From the HEARTLAND of America

From Chicago—the Heartland of America—these three leaders in their respective fields of production and precision can help you with your manufacturing problems.



WALSH 38-Ton Air-Clutch High Production O.B.I. Press Let our experience in the fields of production and precision prove beneficial to you

and your product. Write or phone these Chicago firms for complete information about their important new products and services. In addition, all offer free engineering consultation services. There's no obligation on your part, of course.

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SIMPSON ELECTRIC COMPANY
 5200 West Kinzie Street
 Chicago 44, Illinois Estebrook 9-1121

Panel Meters and Electronic Test Equipment * SIZE CONTROL COMPANY 2500 West Washington Boulevard Chicago 12, Illinois MOnroe 6-6710

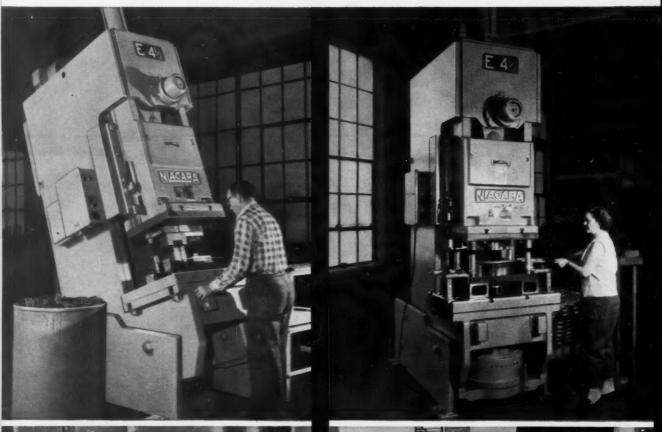
Precision Gages Centerless Lapping Machines WALSH PRESS & DIE COMPANY
 4709 West Kinzie Street
 Chicago 44, Illinois Estebrook 8-6700

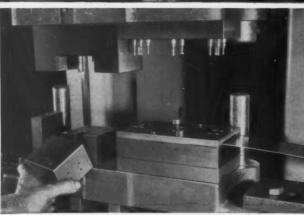
Punch Presses Since 1907

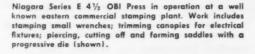
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s Since 1907 Inspection Service for Industry
Standard Transformer Co., Warren, Ohio

Take it from the early birds... "IT'S THE GREATEST









Niagara Series E $4\,1\!/_2$ OBI Press engaged in blanking and drawing of kitchen cannister lids from half-hard aluminum at midwestern housewares manufacturing plant.

"we can produce from 8,000 to 10,000 pieces in an eight hour day"

"has a centralized pressure lubricator which we like very much"

O.B.I. EVER BUILT"

"we find that dies without posts work much better on this press"

"large slide area for large trimming, blanking and progressive dies" and longer runs",





Niagara Series E $5\,1/_2$ OBI Press forming and trimming hemispherical copper parts for one of the "Big Two" electrical manufacturers,

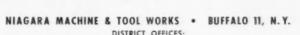
Few developments in metalworking history have drawn the enthusiastic endorsement given Niagara's revolutionary Front-to-Back Crankshaft OBI Press.

Now, as at the 1955 Machine Tool Show where it was unveiled, there is *nothing* even remotely resembling it in the industry...design-wise and production-wise.

Customers in U.S. and Canada...the "early birds" who are doing their modernizing with the most modern press of all...can today tell you about accomplishments with this newest and greatest of OBIs that you would have never dreamed possible. Yes, the press that Niagara conceived to do more than any OBI ever built is doing just that for a fast-growing list of metalworking plants.

There's a huge fund of successful experiences that a Niagara representative can share with you today. Draw on it now and utilize it in your modernization plans. Make a date, at your convenience, for a personal call.

...and if you haven't received new Bulletin 56 with complete design description and specifications (75-200 ton capacities, $4\frac{1}{2}$ - $7\frac{1}{2}$ inch shaft diameters, standard and automated models) write for your copy at once. You will find it invaluable to your planning.



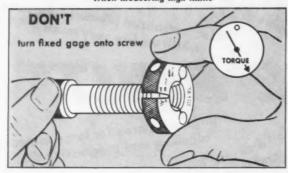
Buffalo • Cleveland • Detroit • Indianapolis • New York • Philadelphia

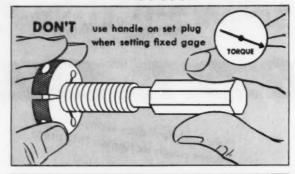
Distributors in principal U. S. cities and major foreign countries

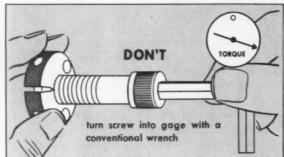
America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work

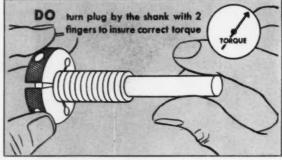


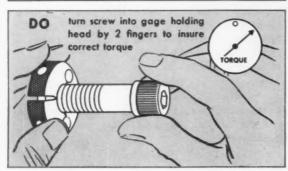
INCLINABLE PRESSES

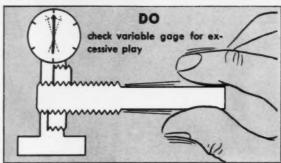












These illustrations from new SPS booklet show some of the do's and don'ts of gaging precision threads.

3A threads: what they are; how to gage them — new SPS booklet tells all

Threads made to Class 3A fit are the most precise in general use in industry. But you do not always get the 3A precision you specify. Because of many different gaging techniques that yield varying results, screws with threads well outside the Class 3A tolerance limits often pass inspection.

SPS has prepared a new booklet on this subject. It explains clearly what Class 3A threads are and the pros and cons involved in the widely varying gaging techniques in use today. It reviews the gaging of high and low limits of 3A threads, sampling techniques, and even the methods of gaging gages.

All standard Unbrako socket screw products fall within specified tolerance limits no matter what method is used to gage them. Leading industrial distributors carry complete stocks. Unbrako Socket Screw Division, Standard Pressed Steel Co., Jenkintown 19, Pa.



Form 2239, "Class 3A Threads: what they are; how to gage them." 16 pages, with many illustrations. Write for free copy today.

STANDARD PRESSED STEEL CO.



NBRAKD SOCKET SCREW DIVISION



Tear this chart out and preserve it

YOUR GUIDE TO COLUMBIA WATER HARDENING TOOL STEEL GRADES

	DESCRIPTION	RANGE	QUENCH	RANGE	HARDNESS
WI Grade 1 Best que	Best quality water hardening tool steel — meets all metallurgical tests	1420° F. to 1530° F.	Water and Brine	350° F. to 500° F.	67/59 Rc
W2 Grade 2 Vanadi	Vanadium treated modification of Columbia EXTRA, fine grained, tough, long wearing carbon tool steel	1425° F. to 1500° F.	Water and Brine	350° F. to 500° F.	64/58 Rc
WS Grade 2 Chromiu WATERDIE EXTRA	Chromium alloyed Columbia EXTRA for increasing depth of hardness and wear properties	1475° F. to 1525° F.	Water and Brine	350° F. to 500° F.	65/56 Rc
W1 Grade 2 Extra que Columbia EXTRA	Extra quality straight carbon tool steel — meets hot-etch and hardenability tests, wide range of uses	1420° F. to 1550° F.	Water and Brine	350° F. to 550° F.	65/57 Rc
W1 Grade 2 Columbia Selected Physics Physics Part Peadle Metallu	Selected carbon with controlled hardenability to meet severe physical requirements of cold heading Metallurgically controlled for center soundness	1470° F. to 1550° F.	Water and Brine	400° F. to 530° F.	63/58 Rc
W2 Grade 3 Vanadium line g	Vanadium treated Columbia STANDARD — a shallow hardening fine grained tool steel for general purposes	1420° F. to 1470° F.	Water and Brine	400° F. to 550° F.	63/56 Rc
W1 Grade 3 Columbia STANDARD	A good quality reliable straight carbon, general purpose tool steel for short run tools not requiring the high physical properties	1420° F. to 1470° F.	Water and Brine	400° F. to 550° F.	63/56 Rc

COLUMBIA TOOL STEEL COMPANY . CHICAGO HEIGHTS, ILLINOIS

CENTRAL OFFICE AND WORKS, CHICAGO HEIGHTS, ILLINOIS — BRANCH STOCKS IN THE FOLLOWING CITIES:

Chicago 32 4832 S. Kedzie Ave. Phone L.Afayette 3-3632

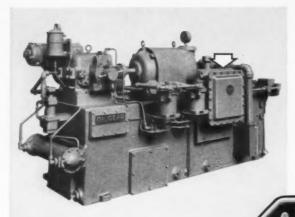
2716 Spring Grove Ave. 1640 St. Clair Ave. Phone MUlberry 1-8400 Phone MAin 1-1785

REPRESENTATIVES IN THE FOLLOWING CITIES: Dayton, Erie, Grand Rapids, Hartford, Indianapolis, Louisville, Moline, Newark, Portland and St. Paul

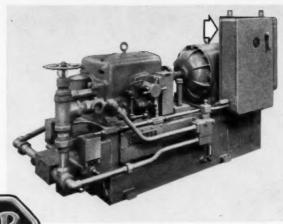


COLUMBIA TOOL STEELS

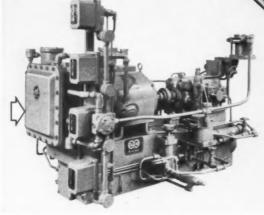
DIE STEELS, Superdie — Atmodie — E.Z.Die Smoothcut — Exl.Die — CEC Smoothcut HOT WORK STEELS, Clarite HW — Formite #3 — Formite #2 — Molite HW 10 — Vanadium Firedie — Alcodie — Firedie "HIGH SPEED STEELS, Clarite — Vanite — Acmite — Cobite — Maxite — Molite Smoothcut — Molite #3



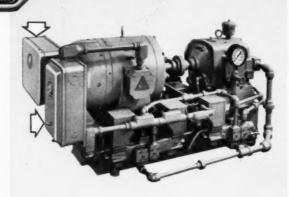
Oilgear Type DXE-825 2-way variable delivery pump for large Cordite press. Allen-Bradley motor controls in Type 7 explosion-proof bolted enclosure.



Oilgear Type DR-3511 1-way variable delivery pump for fluid power to gun gymnasticater. Allen-Bradley motor controls in Type 1 general-purpose enclosure.



Oilgear Type DXG-425 duplex pump for fluid power to large Cordite extrusion press. Allen-Bradley motor controls in Type 7 explosion-proof bolted enclosure.



Oilgear Type DS-825 1-way variable delivery pump for fluid power to machine tool. Allen-Bradley motor controls mounted in Type 1 general-purpose enclosure.

OILGEAR FLUID POWER PUMPS ...use Allen-Bradley Motor Controls

The four powerful oil pumps shown above, and built by The Oilgear Company for delivering fluid power to large extrusion presses and other hydraulic machinery, are factory-equipped with Allen-Bradley solenoid motor starters. The enclosures used are determined by the conditions existing where the pumps are installed.

Why is Allen-Bradley control so popular with machinery builders? The answer is found in the solenoid design. Its one moving part is a virtual guarantee of millions of trouble free operations.

In addition, the double break, silver

alloy contacts—used throughout the Allen-Bradley line—eliminate all need of maintaining contacts—they are always in perfect operating condition. Where botted enclosures are used, maintaining contacts becomes a costly, time-robbing job.

Another outstanding advantage is the protection afforded by the accurate and reliable overload relays. Being solder pot relays, they do not deteriorate with age—they remain accurate and reliable.

Send for a copy of the Allen-Bradley Handy Catalog...a good reference manual on motor controls... manual and automatic. Write for your copy, today.





Bulletin 700 relay for machine tools.

Bulletin 709 solenoid starter removed from enclosure to show arc hood and two overload relays. Available up to 300 hp, 220 v; 600 hp, 440-550 v.

Allen-Bradley Co. 1331 S. First St. Milwaukee 4, Wis.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

QUALITY

In Canada--Allen Bradley Canada Ltd.
Galt, Ont.

a statement concerning machinery replacement

W. V. CASGRAIN, President
MECHANICAL HANDLING SYSTEMS, INC.

"We believe that a planned procedure for the replacement of machinery must be based on a case history of maintenance for each piece of equipment from its date of purchase. This permits us to produce high quality at the lowest cost and allows us to pass on to our customers finely finished products that are essential to both our customers and our own business. We know essential to both our customers are quipment replacement is necessary that a systematic program of equipment replacement is necessary.

"Our plant engineering and maintenance departments,
"Our plant engineering and maintenance departments,
together with our top shop personnel, make a semi-annual
analysis of expenditures made for replacement parts and maintenance labor, as well as the accuracy of pieces produced. From
these data, we determine whether the equipment can be expected
to continue our quality standards or whether it should be
to continue our quality or replacement.

"Our problems have largely been solved by the application of the M.A.P.I. formula. This has enabled us to budget the necessary funds required for a practical and orderly program of equipment replacement."



Rockford Insert Group

planers in one machine



Pendant control of range and cutting speed selection.

Maximum return speed regardless of cutting speed.

Quick reversals with minimum overtravel.





MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

with hydraulic triple circuit

h3 drive

low speeds to 100 fpm. with force for heavy cuts medium speeds to 150 fpm. with force for normal cuts high speeds to 300 fpm. with force for light cuts

H3 drive is an exclusive new feature on Rockford Hydraulic Planers. In the three speed circuit, a double acting cylinder opposed by a single acting cylinder are employed, giving three speed ranges with the power inversely proportional. The hydraulic triple circuit provides the correct speed and force—in one machine—to most economically machine every type of metal. Ask a Rockford Machine Tool Co. representative for further information, or write direct.



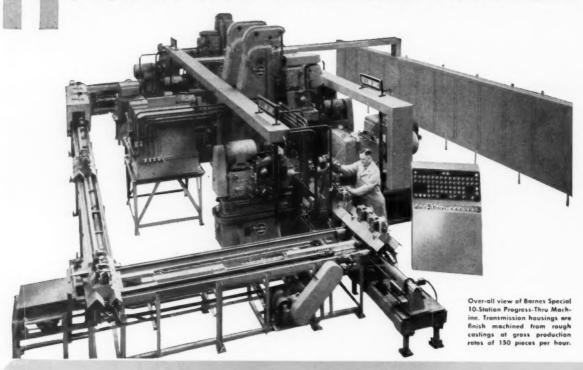
ROCKFORD MACHINE TOOL CO. 2500 KISHWAUKEE STREET • ROCKFORD, ILLINOIS

h





OUSINGS NOW MACHINED COMPLETE



Rough & semi-fin. bore, chamfer

Spot

& chamfer

(Horiz, Head) Fin. in b Idle & semi-fin, bore bu

DATEDAT

Press Finish

bushing fin. c'bore housing Idle

LOAD WO PARTS

Rough mill & rough face

Semi-fin. Semi-fin. reom, mill, chamfer, chamfer & semi-fin. face

Fin, mill & Fin. ream



Builders of Better Machines Since 1872

▲ Schematic drawing of machining operations. Total concentricity on all operations does not exceed .002". Housings are hold in transfer plates which are located by two hydraulically actuated dowels and clamped hydraulically at each machining station.



Special Machine Tools



Special Conveyor Unit



Special

MULTIPLE SPINDLE DRILLING

BORING

TAPPING MACHINES



Machinery, July, 1957

MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

FROM ROUGH CASTING TO FINISHED PART



Transmission extension housings are finish machined in automatic cycle from rough casting to finished workpiece. After rapid washing and final inspection, the part is ready for assembly.



View of workpieces in special transfer plate fixture. Both housings are located and accurately positioned by means of dowels and screw-operated V-block clamps.

ON

W. F. & JOHN BARNES SPECIAL 10-STATION PROGRESS-THRU MACHINE

Here is another typical example of how W. F. & John Barnes Six-Point Machine Tool Building Service has helped increase production efficiency for a leading automobile manufacturer. All machining operations on transmission extension housings are now combined in one Special Barnes 10-Station Progress-Thru Machine at a production rate of 150 pieces per hour. Two operators, one at the loading end and the second at the unloading end, load and unload housings on transfer plates which carry workpieces through the entire machining cycle. Operations include boring, facing, milling, drilling, reaming, automatic press-in of babbitt bushings, and combination finish bore babbitt bushing and finish counterbore housing.

Whether your production requires large or small machines, you'll find the coordinated services at Barnes can help you solve problems quickly and efficiently.



Closeup of station seven where babbitt bushings are automatically pressed-in to the small end of the housings. Bushings are hopper loaded by operator at the unloading station.

BARNES' COORDINATED 6-POINT MACHINE TOOL BUILDING SERVICE INCLUDES:

- SPECIALIZED MANUFACTURING FACILITIES

 —75-year background, large well equipped
 plant efficiently tooled to build high pro-
- SPECIAL HYDRAULIC EQUIPMENT—designed and built to meet JIC standards. Individually engineered units assure smooth, dependable actuation for every requirement.
- SPECIAL ELECTRICAL EQUIPMENT and CONTROLS individually designed and built for maximum safety and ease of control, with circuits that assure the most dependable coordination of all machine functions.
- SPECIAL GAUGES, FIXTURES, TOOLS designed for each individual machining problem, assure accuracy of operations at high production speeds.
- SPECIAL HANDLING AND CONVEYOR EQUIP-MENT — designed and built to reduce work hendling, effect maximum safety and effrience.
- COORDINATED DESIGN AND ENGINEERING
 —Mechanical, Hydraulic, Electrical, Process,
 Tool, and Fixture Engineers work together at
 Barnes. Team-work solves complex problems
 quickly.

WEITE TOR

Ask for free booklet "Coordinated Machine Engineering" describing the scope of Barnes machine tool building service.



W. F. & JOHN BARNES COMPANY

MACHINE TOOL DIVISION

402 SOUTH WATER STREET, ROCKFORD, ILLINOIS



Special Electrical Controls



Food Machinery

AUTOMATIC PROGRESS-THRU AND TRANSFER TYPE MACHINES



"Engineered Production" Service



It takes 3

American's "Engineered Production" Service

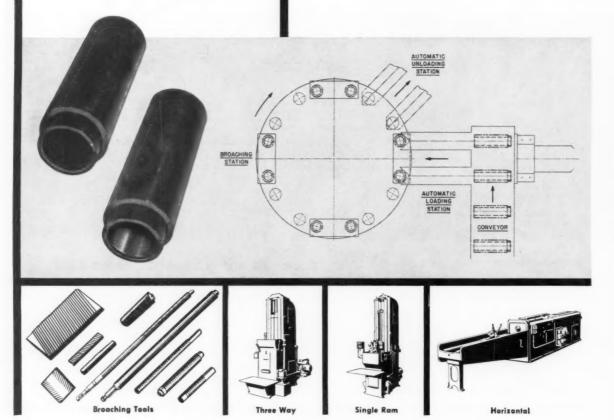
... gives the broach-user the complete three-part service that is essential to obtain the most practical broaching method. Years of design and production engineering experience, unavailable at any price, are effectively added to your staff at no extra cost.

THE JOB — Broaching the I.D. of transmission brake sleeve parts, two at a time, in a fully automatic cycle with a high production rate required.

THE RESULT—300 completed parts per hour in an electrically controlled and interlocked automatic cycle.

PROPER BROACH

Top-quality results on any broaching operation require starting the job with design of the broaching tool itself. In solving this all important first step, American Broach considers stock removal, length and width of cut, finish tolerances required, etc. High-quality work and long tool life result because broach and machine are designed to operate as a team. In this installation the two broaches move downward simultaneously during the cutting stroke. Next, the table indexes and the two broaches are returned to retriever automatically for return to starting position for the next broaching cycle.





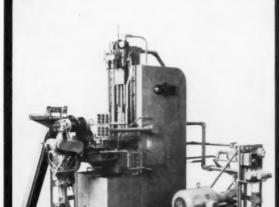
Machinery, July, 1957

CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.

to give you peak broaching performance

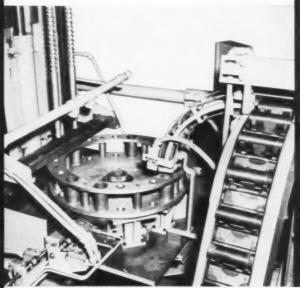
SPECIFYING THE RIGHT MACHINE

Production rate required, length and speed of stroke, relationship to other production machinery, available floor space, etc. determine the selection of the broaching machine capable of doing the best job. At American, machine selection follows design of the broaching tool. This vertical hydraulic internal pull-down machine is provided with separate hydraulic circuits for machine operation and index unit. Part elevator is motor-driven, uses air cylinder for parts loading.



EFFICIENT FIXTURING

Whatever your parts geometry or hourly needs, fixturing by American Broach forms the vital third link in the production chain. As shown in the close-up, two parts are loaded at a time in the eight-station dial type indexing fixture. Discharge is automatic as parts ride off skid plate and drop into discharge chute. This installation is another example of how "skills" built into the tool, machine, and fixtures make sure that production schedules can be maintained even with inexperienced operators.



Get more facts in American's Pull-Down Bulletin A616. Write for your free copy today.



Duplex Ram



Presses



BROACH & MACHINE DIVISION

SUNDSTRAND MACHINE TOOL COMPANY ROCKFORD, ILLINOIS



These MATTISON "GIANTS" make surface





Machinery, July, 1957

CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.

with stepped-up horsepower grinding more profitable!

NOW... MACHINE LESS METAL, SPEED LOADING AND UNLOADING, CUT THROUGH TOUGH SCALE FAST AND EASY

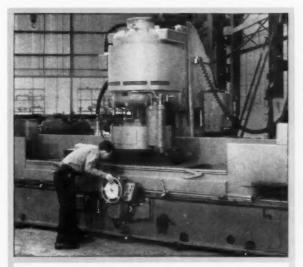
These Mattison machines combine large size with tremendous horsepower not usually associated with grinding, and make possible major savings in machine time and time of skilled operators. Now, large pieces can be set up on magnetic chucks and ground in less time than it ordinarily takes to locate them and clamp them in a fixture. You can reduce the weight of large castings and minimize the amount of metal being removed because stock allowances need not be as great. On large production runs, material costs can be reduced substantially.

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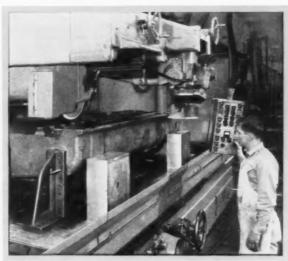
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Think of what these grinders mean in terms of tool life and efficiency when machining tough forgings and castings from the rough. They take these cuts in stride, getting under scale and removing a sizable amount of stock in a single pass. Hard spots have little effect on the wheel. Accuracy goes up, too. Large, uninterrupted surfaces can be ground using minimum wheel clearance—finishing cuts can be taken with wheels set dead flat. Hardened ways can be ground to a flatness of split thousandths, and results compare favorably with the finest hand scraping. Hardened surfaces that cannot be scraped are ground easily.

Call your Mattison dealer and arrange to have sample parts ground in the Mattison Methods Laboratory.



40055 Vertical Spindle Surface Grinder, with 100 hp spindle motor, is designed for fast stock removal and precision production of elongated parts or full chuck loads of smaller castings. Extreme accuracy is possible because the table never overhangs the bed. Magnetic chuck enables parts to be positioned or released without time-consuming handling of bolts, clamps, etc.



Combination Way and Surface Grinder brings you a faster, more precise method for machining several surfaces in different planes in a single setup. Unique three-column design provides rigid support for the two spindles. You can take a variety of cuts, such as dovetails, contours, etc., holding accurate alignment between surfaces. All machine motions are easily controlled from the pendant.



HIGH-POWERED PRECISION SURFACE GRINDERS

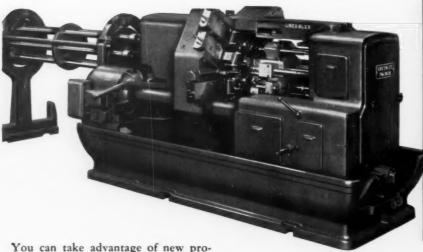
If it's a flat surface, there's a Mattison grinder to "machine" it!

Machinery, July, 1957

FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.



greater accuracy, faster production



WITH
GREENLEE
SIXSPINDLE
AUTOMATICS

You can take advantage of new production techniques...attain higher levels of efficiency with the improved Greenlee 6-Spindle Bar Automatic. Its advanced design opens the door to some real profit opportunities. • These design improvements are fully described in a catalog recently issued. Let us send you a copy today. Find out how Greenlee Automatics can save time and money in your plant. It will pay you to investigate.

IMPROVED SPINDLE CONSTRUCTION

The spindle has been completely redesigned to assure greater accuracy at higher speeds. True running...the new Greenlee spindle has five widely spaced, preloaded, angular-contact, precision ball bearings. Entire spindle is dynamically balanced for smooth operation. Metallic seals, labyrinth and friction washers with line contact provide maximum heat dissipation.

INCREASED SPEED

Spindle speed range has been increased. Enables you to take full advantage of the top efficiency and peak performance which carbide and high-speed tooling offer. Reduces downtime losses and tool costs.



WRITE FOR CATALOG No. A405



GREENLEE BROS. & CO. 1867 Mason Avenue Rockford, Illinois



Machinery, July, 1957

CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.

You get top value per dollar with a Hendey No. 2E Lathe

timesaving controls step up efficiency of toolroom or production turning!



Because all controls were designed with the operator in mind, the Hendey No. 2-E generalpurpose lathe today is setting new standards of efficiency on both toolroom and production jobs. Two outstanding features are the electronic drive that permits infinitely variable speed control, and the instantaneous dynamic brake for rapid stopping and reversing of

Here are more Hendey "top-value" features you'll want to check further: quick-change gearbox providing 48 changes of threads without changing gears; thread-chasing dial for returning carriage to the same thread groove; quick-change gearbox for 48 changes of feed without gear change; pushbutton energizing of main motor; and two control levers, permitting operator to start, stop, or reverse the spindle from any working position. Contact your nearby Hendey dealer for complete details and specifications.



for precision with production, buy Fendey

ER-COLMAN COMPANY

72 Loomis St., Rockford, Illinois





EKSTROM, CARLSON

RADIAL-ARM DEPTH AND CONTOUR MILL

Here is the fastest and most economical machine you can buy for profile and contour work — a manually-operated, radial-arm mill. Outstanding performance results from daring, up-to-date design based on solid machine tool standards and a long-time knowledge of high-speed cutting. If you are interested in low initial cost, low maintenance, and high production capacity, let us tell you more about our No. 480 Mill. (It is being used for producing important parts of the B-58.)



EKSTROM, CARLSON & CO. 1400 Railroad Ave., Rockford, III.





improved wear characteristics

greater abrasive support

for bores up to 4"

This new BarnesdriL Honing Tool design means more efficient honing operations because it supplies better abrasive wear characteristics and greater strength at the point of cutting. The tool has very few parts in its simple construction, and may be designed for use with either a floating or rigid fixture. BarnesdriL wing-type abrasive stones are pressfit between standard hardened inserts which act as side supports for the stones as well as guides in the bore. Fiber jackets reduce stone wear by protecting the inserts against the abrasive and serve to hold the wing-type stones firmly in place.

Fully protected by patents, this new honing tool will improve your honing operations and reduce honing tool costs on honing operations. See your BarnesdriL representative, or send us prints of your honing operations for recommendation.



BARNES DRILL CO.

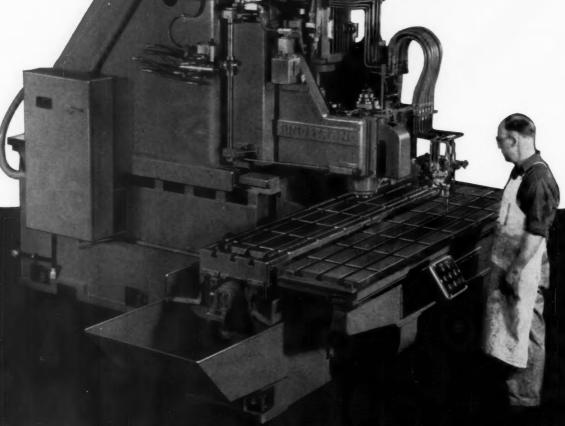
820 CHESTNUT STREET • ROCKFORD, ILLINOIS DETROIT OFFICE: 3419 South Telegraph Road



NEW

SUNDSTRAND VERTICAL TRACER RIGIDMIL PROVIDES 3-DIMENSIONAL CONTROL

Power and rigidity of the new Sundstrand Vertical Tracer Rigidmil make it ideal for taking irregularly shaped cuts in either ferrous or nonferrous metals.



AUTOMATIC LATHES | SIMPLEX RIGIDMILS | DUPLEX RIGIDMILS

SUNDSTRAND

"Engineered"

Production

Service*









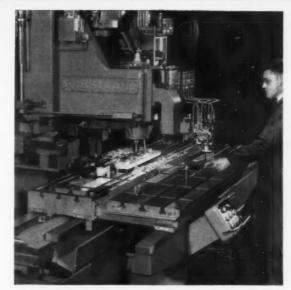
Machinery, July, 1957

MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

SIMULTANEOUS control of horizontal, vertical, and cross feed is an outstanding feature of the new Sundstrand Tracer Rigidmil. Adequate power for milling from the solid is provided by the 30 hp milling head. You're sure of being able to use the right cutting speed for machining ferrous or nonferrous metals with either HSS or carbide because the Vertical Tracer Rigidmil has both wide speed range and rigid construction.

Vertical spindle head has a low speed range of 52 to 307 rpm at a maximum of 15 hp and a high speed range of 338 to 1990 rpm at 30 hp maximum. Speed range required for a particular machining job is selected with the two-position lever conveniently located on the side of the head. Additional speed changes within the range selected are made by pick-off change gears.

Head is mounted on vertical ways of a cross-traveling column. The vertical travel of the spindle head is 20" and cross-travel is 24" (12" either side of table centerline). Machine and template tables both have



Shown above is the Vertical Tracer Rigidmil performing 360 degree tracing on aluminum parts.

TYPICAL CUTS

Here are only a few of the irregularly shaped cuts that can be made on parts such as bulkheads, wing spars, wing caps, etc. in either ferrous or nonferrous metals.







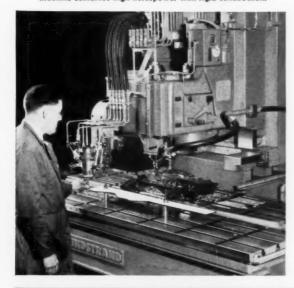








Sizable cuts are readily handled when machining steel because machine combines high horsepower with rigid construction.



a working surface of 18" x 90". Machine table travel is 60". Head carrier cross feed and table longitudinal feed are infinitely variable between 0 and 28 ipm. Both have a rapid traverse rate of 80 ipm.

The pencil-type stylus control can be set for either 3-dimensional tracing or for 360-degree tracing in the horizontal plane. When using 360-degree tracing, depth is controlled precisely by means of eight manually selected, adjustable vertical stops. The valve has a quick-change stylus chuck and manual adjustment for limiting maximum feed rate.

More Tracer Milling Facts

... using the new Vertical Tracer Rigidmil are contained in Bulletin 681. Write for your copy today.



SPECIAL MACHINES



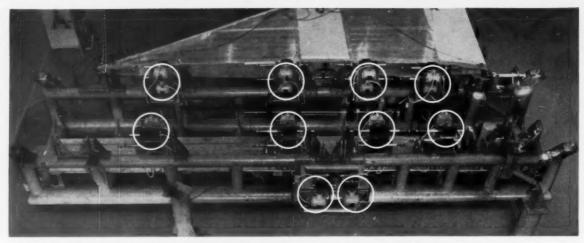


SUNDSTRAND Machine Tool Co.

2530 Eleventh St. . Rockford, III., U.S.A.

Machinery, July, 1957





Precision Boring In Assembly with

GREENLEE HYDRO-BORERS

Build precision boring right into your production setups! Shown in the Convair wing job above, sixteen model S-6 Hydro-Borers and four special Hydro-Borers are mounted directly on the wing jig. They are specifically designed for mounting on jigs and multiple-station machines. Find out how Greenlee Precision Hydro-Borers simplify your production setups . . . save time, space and money . . . and bore to a tolerance of .0003".



Model C-4 Hydro-Borer is easily mounted on any type of base. Fixtures mount on face of machine. Adjustable stop in either direction. Optionally furnished with automatic trip and spindle return.



Model S-6 Hydro-Borer can be mounted in various positions on workholding fixtures and assembly jigs. Capable of various feeds in two ranges: .002" to .004" and .0035" to .007" per revolution.

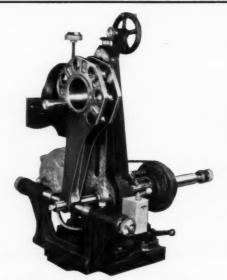


GREENLEE BROS. & CO. 1867 MASON AVENUE Rockford, Illinois Telephone 3-4881



Similar to model S-6 except larger and heavier with greater work capacity. Combines versatility and precision unmatched in its field and range of operations. Patented feed principle enables boring within a a tolerance of .0003".

WRITE FOR FURTHER INFORMATION



MODEL A-4 MASTER ROD HYDRO-BORER

Model A-4 Hydro-Borer for boring crank-pin holes and wrist-pin holes in aircraft engine connecting rods.



Machinery, July, 1957

MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.



Removing metal fast from hard alloys— HAYNES STELLITE alloy tool removes surface imperfections from a hard chromium-nickel ingot. The 98M2 tool is the only one that will handle this machining job successfully.

For more information, write for our Metal-Cutting Tool Manual. Address Haynes Stellite Company, Division of Union Carbide Corporation, General Offices and Works, Kokomo, Indiana.

HAYNES

HAYNES STELLITE COMPANY
Division of Union Carbide Corporation

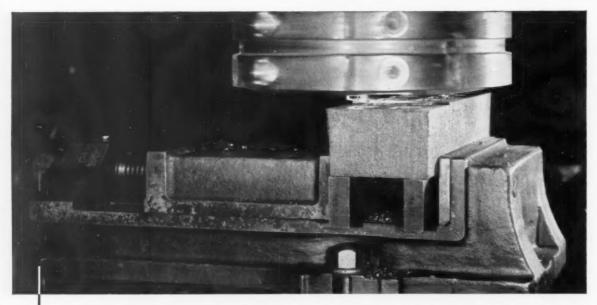
UNION CARBIDE

"Haynes," "Haynes Stellite" and "Union Carbide" are trade-marks of Union Carbide Corporation



On any material, any job . . .

INCREASE PRODUCTIVITY, CUT UNIT



Output boosted 20%-30% with Grade 860

Milling gray cast iron. Cemented carbide increased production, yet provided longer tool life, better finishes on the new hard, dense types of gray cast iron. Tests on simulated engine blocks (above) showed Grade 860 took interrupted cuts with minute wear, no chipping . . . while other carbides showed extensive chipping and cratering.

Production rate doubled with Grade 370 tool

Turning 4340 steel. High-impact cutting involved on this special aircraft shaft caused rapid dulling of conventional carbides; several work stoppages per shaft occurred while tools were reground. Today, Synchro Devices, Inc., turns a complete shaft with a single Grade 370 tool . . . also gets double the production.

Daily regrinding ended by Grade 883 cutters

Gang-milling plastics. Cotton-impregnated plastic-like plugboards were so abrasive that steel cutters were down for costly, time-consuming regrinding almost daily. Switching to Carboloy Grade 883, International Business Machines Corp. milled 900,000 boards with the carbide-tipped cutters without sharpening.



COSTS WITH CARBOLOY CARBIDES

- Take heavier cuts, at faster speeds and feeds
- Lower tool cost per piece, boost machine efficiency

Whether you're cutting steel, cast iron, aluminum—or even nonmetallics like plastics—Carboloy carbide grades will keep machines running longer at top efficiency.

Carboloy cemented carbides make your machines more productive because they take greater speeds and feeds . . . give you more output per grind. And, they'll cut unit costs through lower downtime, grinding, and maintenance costs . . . give you more production per tool. It adds up to a more efficient — and therefore, more profitable — machining operation.

Wide choice of grades

If you're cutting steel, for example, use Carboloy Extra-Performance Grades 350 and 370. These grades have proved their superiority over conventional carbides in hundreds of applications . . . doubling and tripling production in many cases.

If you're milling high-tensile cast irons, there's Carboloy Grade 860. This carbide provides greater

resistance to chipping and cratering. Tests show it can increase production 20%-30%.

Or, if you're machining nonferrous materials like aluminum, brass, bronze, or titanium, you can choose from five Carboloy cemented carbides . . . and get the specific cutting characteristics you need for any job from precision finishing to heavy-duty interrupted cuts.

Broad range of products

Carboloy cemented carbides are locally stocked for immediate delivery by 139 Authorized Carboloy Distributors. They're available in the widest choice of styles and sizes in the industry.

Call your Distributor today (he's listed in the Yellow Pages). Or, send for a copy of Catalog GT-316, containing the new Grade Selection Guide for Carboloy cemented carbides. Write: Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Road, Detroit 32, Michigan.

Progress Is Our Most Important Product

GENERAL (ELECTRIC



How to get full value from your automatic machine tools...at no extra cost

EVERY time you stop to adjust your automatic machine tools, you reduce their potential. But if the steel you machine is uniform, you reduce these costly interruptions. The more uniform the steel you machine, the more available your machine tools become for increased production.

Timken® fine alloy steel is uniform from bar to bar, heat to heat, order to order. We take extra quality control steps to make it that way. For example, we use a magnetic stirrer—the first in the U. S.—to distribute alloys equally in molten steel, keep temperatures constant, work the slag continuously. The industry's first direct-reading spectrometer insures uniform composi-

tion right up to the tapping-helps keep grain size uniform, too.

And your order is handled individually. We stamp each bar to identify its heat, even adjust our conditioning procedure to meet your end use requirement.

We're steelmakers because we need the finest quality steel for Timken bearings. The Timken steel you buy must meet these same exacting standards. Always specify Timken fine alloy steel. You'll get time and money-saving uniformity, a more uniform finished product. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, O. Cable: "TIMROSCO".

TIMENTED STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

90-MACHINERY, July, 1957

Crucible gives you wide selection, dependable delivery of

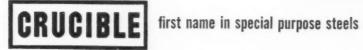
Cold Rolled **Specialty Steels**

For a full selection of cold rolled specialty steels - call Crucible. Deliveries are on-schedule – in the size, grade, finish or length you need.

And Crucible's new mill facilities mean closer control of rolling ... insure greater physical uniformity ... fine finish ... better edges ... flatter strip.

Whether you use carbon spring steel, alloy strip steel, or many other ferrous analyses that can be cold rolled, you can't beat Crucible. More information is contained in the 32-page booklet, "Cold Rolled Specialty Steels". Write for your free copy now. Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.





Steel Company of America

For more information fill in page number on Inquiry Card, on page 259

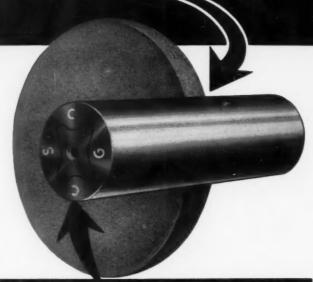
MACHINERY, July, 1957-91

An exclusive GRINDING PROCESS...

makes

CUMBERLAND STEEL BARS

concentric, straight, smooth & really accurate



BE SURE OF THIS MARK ON THE END OF YOUR SHAFTS

CUMBERLAND GROUND BARS FOR ALL TYPES OF MACHINES

They are carefully ground to our standard manufacturing tolerance, plus nothing to minus .002" on diameters 1-1/8" to 2-7/16" inclusive . . . plus nothing to minus .003" on diameters 2-1/2" to 8" inclusive. Closer tolerance can be furnished, if desired. And, remember, Cumberland Steel Bars are the end result of 109 years' experience,—and every bar is carefully tested before shipment. The list of Cumberland's customers reads like the "Blue Book" of Industry. Ask for further information.

MANUFACTURED IN THREE SPECIFICATIONS

Cumberland Brand—AISI C-1020/C-1025, Elastic Limit 30,000# Min.
Potomac Brand—AISI C-1040, Elastic Limit 45,000# Min.
Cumsco Brand—AISI C-1141, Elastic Limit 57,000# Min.

CUMBERLAND STEEL COMPANY

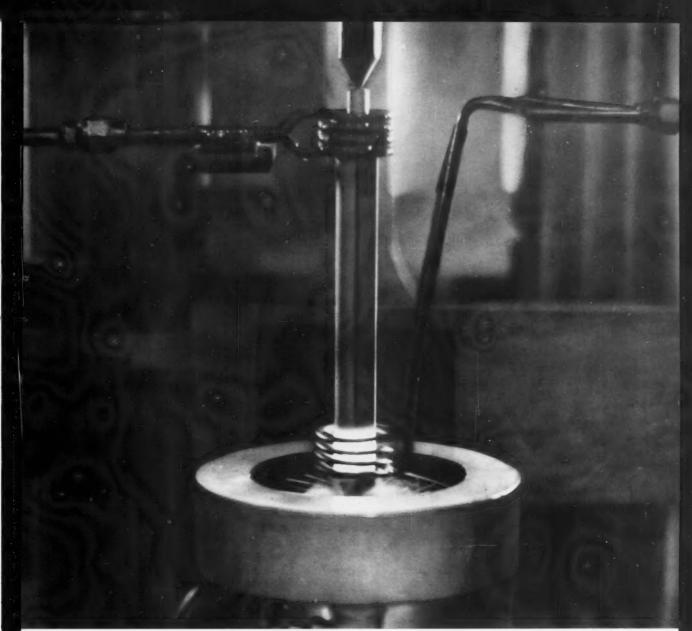
CUMBERLAND, MARYLAND, U.S.A.

ESTABLISHED 1845

INCORPORATED 1892

92-MACHINERY, July, 1957

For more information fill in page number on Inquiry Card, on page 259



Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change...

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor - Railway & Power Engineering Corp., Ltd.

Mast of SHELBY SEAMLESS TUBING

(USS STAINLESS STEEL)

provides high strength and corrosion resistance for coaxial antenna

The Type 3006 Coaxial Colinear Antenna*, consisting of three half-wave vertical dipoles arranged colinearly and operating on a frequency range of 152-176 MC, is especially suitable for patrol car broadcasting. The three vertically arranged dipoles exhibit a gain of 5 to 6 db over a standard single dipole, and produce a low angle of radiation with equal radiation in all directions.

This $13\frac{1}{2}$ -foot, 40-pound antenna is supported by a mast made of Shelby Seamless Tubing (USS Stainless Steel) running through its center. In addition to possessing the tensile strength to withstand 100-mile-per-hour winds, this stainless supporting mast has high corrosion resistance—will not flake from oxidation and cause short circuits.

In such critical applications where superior strength, uniformity, dimensional accuracy and corrosion resistance are needed, Shelby Seamless Tubing of USS Stainless Steel is consistently chosen to meet the requirements. Shelby Seamless Tubing, available in a wide range of diameters, wall thicknesses, various shapes and steel analyses, is produced to exacting standards by the world's largest manufacturer of tubular steel products. If you wish, our engineers will make a study of your requirements, and will help you apply Shelby Seamless Steel Tubing to your specifications.

*Name of manufacturer on request.



NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA. (Tubing Specialties)

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS . UNITED STATES STEEL EXPORT COMPANY, NEW YORK



SHELBY SEAMLESS MECHANICAL TUBING

UNITED STATES STEEL

DO YOU NEED BETTER METAL CLEANERS FOR THESE JOBS?



Will you take a few seconds to check this list and circle in the coupon the numbers of the jobs on which you need better results?

1	Cleaning aluminum in preparation for anodizing. See pages 4 to 8 in "How to clean metals in aircraft production."
2	Cleaning and deoxidizing aluminum in preparation for spot welding. See pages 10 to 14.
3	Cleaning and conditioning aluminum in preparation for painting. See pages 15 to 19.
4	Cleaning aluminum after heat treating. See page 20.
5	Stripping paint from aluminum. See pages 22 to 26.
6	Cleaning magnesium. See pages 27 to 29.
7	Controlling overspray in paint booths. See pages 36 to 37.
8	Cleaning engine test cells. See page 40.

FREE Write for your copy of this 48-page illustrated booklet.

Oakite Products, Inc., 26 Rector St., New York 6, N. Y.

Send me a FREE copy of your booklet "How to clean metals in arcraft production."

I am interested in getting better results in the cleaning jobs indicated by the numbers I have circled below:

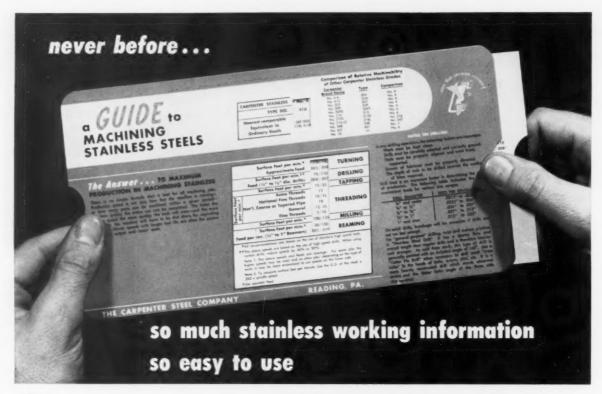
OAKITE

OAKITE

NAME

COMPANY

ADDRESS



Carpenter's new stainless slide chart is a guide

Here's the newest example—just off the press—of how Carpenter printed information is designed to help you and your men when working with stainless.

Now, right at your fingertips, you can have practical data to help you make the most of every pound of stainless you use . . . quickly answer many time-consuming daily questions.

For the first time, with slide chart ease, accuracy and convenience, you can quickly uncover working information about machining speeds and feeds, for turning, drilling, tapping, threading, milling and reaming. One entire side is devoted to such helpful facts as these—all taken from Carpenter's widely used "Notebook on Machining Stainless Steels".

The reverse side is equally valuable. Completely up-to-date, it gives the relative workability for many stainless grades . . . helps you quickly pinpoint the proper stainless for drawing, forging, heading, swaging, welding, buffing, etc.

For your personal copy, simply drop us a line on your company letterhead. If you'd like some extra copies of this NEW Carpenter Stainless Slide Chart for others in your plant, just tell us.

These formulas are just a sample of the help you can expect from Carpenter's NEW Stainless Slide Chart.

No. 1 — for obtaining tap drill size:

$$\frac{\text{Outside}}{\text{Diameter}} \left\{ - \frac{.0130 \times \% \text{ Full Thread}}{\text{Number of threads per inch}} = \text{Drill Size}$$

.250
$$-\frac{.0130'' \times 75}{20}$$
 = .2013 or number 7 drill

No. 2 — for obtaining percentage of thread a given drill will produce:

$$\frac{\text{(Outside dia.} - \text{drill size)} \times \text{number threads per inch}}{.0130} = \frac{\% \text{ of full}}{\text{thread}}$$

$$\frac{(.250 - .201) \times 20}{.0130} = 75.4\%$$
 thread





Free-Machining Stainless Steels

The Carpenter Steel Company, 105 W. Bern St., Reading, Pa. Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"



Tool Steel Topics



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA

Copper Dutelburger

BETHLEHEM TOOL STEEL ENGINEER SAYS:



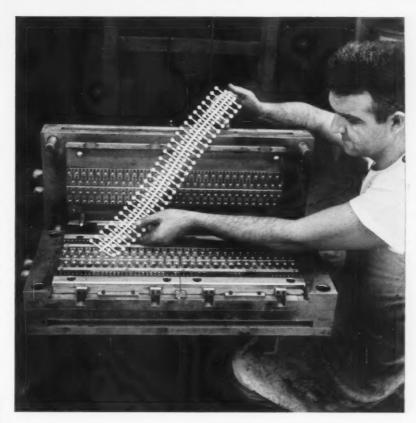
Air-Quenching Adds to Life of Hot-work Tools

Most hot-work tool steels can be hardened by quenching in oil or air. Because of convenience in handling, and in order to avoid excessive scaling, many hot-work tools are oil-quenched. However, airquenching is better practice because airquenched tools have lower residual stresses than tools which have been liquid quenched. Since heat-check failures develop from surface stresses produced in service, the presence of residual stresses in the tool itself can lead to premature failure. Tools with low residual stresses are best suited for long service life on hot-work applications. That's why airquenching is usually considered the most practical procedure for hot-work tools.



Putting the Bite in Chisel Steel

At Stanley Tool's Atha Plant, Newark, N. J., dies of Bethlehem Lehigh H tool steel are used in trip hammers of this type to forge cold chisel blades. Lehigh H, our special-purpose high-carbon, high-chromium grade, is ideal for this type of application because of its excellent wear-resistance and adequate red hardness.



INJECTION MOLD OF DURAMOLD B

Pops Out Plastic Poppit Beads

This injection mold, containing 120 cavities, is used in an 8-oz injection machine to produce one size of the popular polyethylene Poppit Beads. The mold is made of Bethlehem Duramold B tool steel, and was produced by R. A. Koegl Stamp & Die Works, Hillside, N. J., from steel supplied by Ackerlind Steel Co., Inc., New York.

Duramold B is an oil-hardening, chromium-type of plastic-molding die steel, with an addition of boron. In heat-treatment, it develops a surface hardness of Rockwell C62.

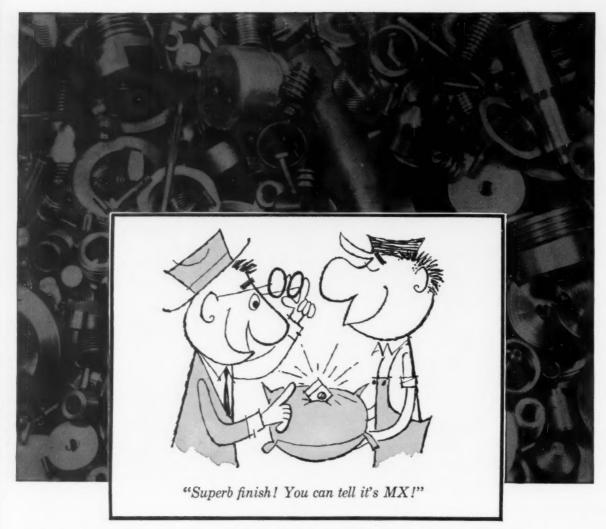
Duramold B is ideal for long service life because of its high core-strength and

resistance to wear. Toolmakers are sure to like it because it can be annealed to a hardness of 100 max Brinell, which permits easy cold hobbing, even where deep or large cavities are used.

Typical Analysis

Carbon 0.07 Manganese 0.30 Silicon 0.15 Chromium 1.00 Molybdenum 0.25 Boron added

To order a trial piece of Duramold B, or obtain detailed information about this or any other grade in Bethlehem's complete family of tool steels, simply get in touch with your Bethlehem tool steel distributor.



"Production increased 27%—finish excellent." "Costs reduced 24% with finish greatly improved." "Tool life increased 200%—superior finish."

These are statements we get from shops reporting on results they have obtained with USS MX Free-Machining Steel. Invariably they have good things to say about the finish of parts made from USS MX Steel.

In other words, this fast-cutting screw stock does more than boost output, increase tool life and cut costs. It enables you to produce parts that have the clean, sharp finish that stamps them as a quality product and makes them easier to sell.

The better finish you get with USS MX Steel results from two important properties — superior machinability and consistent uniformity . . . uniformity in cutting characteristics, in composition, and in freedom from injurious imperfections.

These qualities of MX Steel, maintained in shipment after shipment, not only beneficially affect part finish, but help to keep rejects to a minimum due to the fact that they make it possible to produce parts of close dimensional accuracy throughout the run.

Why not give MX Steel a trial in your own shop? It costs no more than

ordinary screw stock.

Available in both Bessemer and Open Hearth grades, USS MX Free-Machining Steel is produced in all the popular screw stock sizes. It is sold in cold-finished form by your regular supplier, under either our trademark "MX" or his own identifying mark. "MX" Steel is available in hot-rolled form through any USS Sales Office.

UNITED STATES STEEL CORPORATION, PITTSBURGH AMERICAN STEEL & WIRE DIVISION, CLEVELAND COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. UNITED STATES STEEL SUPPLY DIVISION

UNITED STATES STEEL SUPPLY DIVISION WAREHOUSE DISTRIBUTORS, COAST-TO-COAST UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Better finish...fewer rejects...lower costs



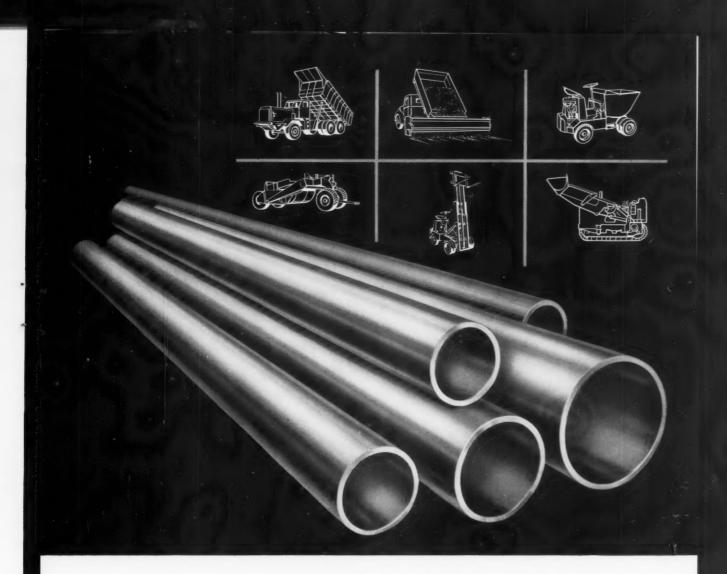
- when you do the job with free-machining



UNITED STATES STEEL

98-Machinery, July, 1957

For more information fill in page number on Inquiry Card, on page 259



This B&W Welded Mechanical Tubing Was Ready for Use on Delivery

Guaranteed Maximum Average Micro-inch Finish on the I.D. to Meet Hydraulic System Needs

B&W ERW Mechanical Tubing, with smooth I.D., can be delivered to you ready to use in hydraulic systems. Where inside surface is of prime importance and no stock removal is planned prior to application, this tubing is made for the job because it is furnished with a smooth inside surface having a guaranteed maximum average micro-inch finish.

In addition to smooth inside finish, this B&W Tubing assures you of uniform wall thicknesses, plus uniform and close I.D. tolerances. It combines light weight and high strength. It means long life and better performance in fluid systems for heavy duty or automation applications.

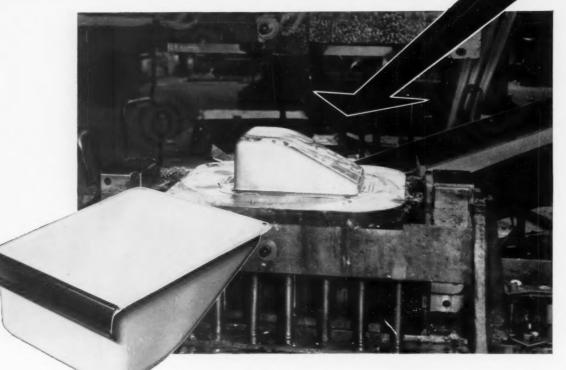
For complete information on B&W ERW Mechanical Tubing with smooth I.D., or on any tubing problem, call for Mr. Tubes—your direct link with B&W. Write for Bulletin TB-419. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.



Seamless and welded tubular products, seamless welded fittings and forged steel flanges—in carbon, alloy and stainless steel.

Here's how A-L CAST-TO-SHAPE TOOL STEELS

solved a serious scrap problem on this job



SEND FOR THIS **NEW CATALOG**

"FORGING AND **CASTING PRODUCTS**"

Contains the latest informa-tion on FCC Air Hardening, Oil Hardening and other Cast-to-Shape Tool Steel Cast-to-Shape Tool Steel Specialties that can save you time and money . . . also Composite Die Sections and Smooth Ham-mered Forgings in a wide range of tool and stainless steels. Get your copy NOW

> ADDRESS DEPT. M-91

A well-known manufacturer of electrical appliances formerly used dies of alloyed ductile iron castings to draw refrigerator crisper pans.

These dies had to be redressed after every 10,000 pieces (approximate cost: \$1300 each) and had to be replaced after every 30,000 pieces. 8 to 10% of the pans were scrapped due to defects.

Because of this scrap problem and the severity of the draw-a 52% reduction of the steel-it was decided to rebuild the dies using a suitable grade of tool steel.

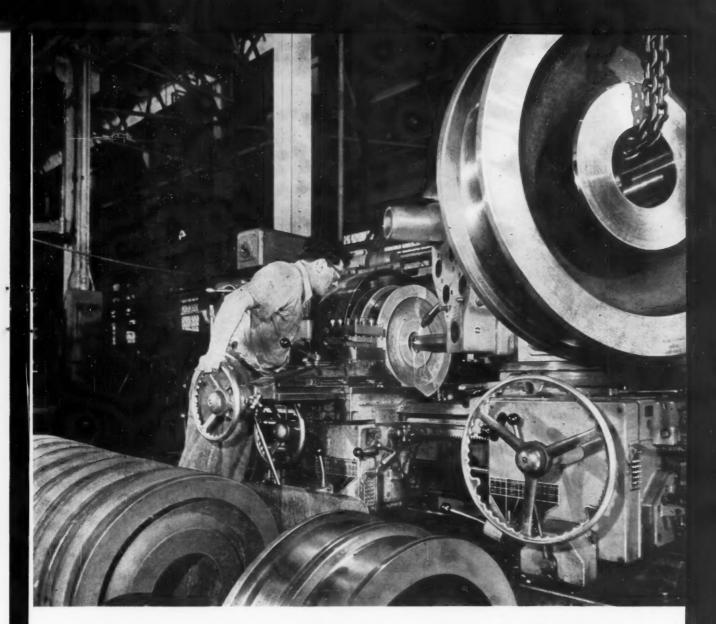
A 2" cut was taken off the top of the old cavity and the draw ring. These cuts were replaced with A-L Cast-to-Shape tool steel rings of high carbon-high chromium analysis. Total cost was nominal compared with buying entirely new dies.

Each of the revised dies has produced approximately 500,000 pans. Their condition indicates that probably twice that many can be drawn before the dies must be redressed. Defective pieces have been reduced to a mere 11/2 to 2%-an 80% reduction!

 Ask your A-L representative TODAY how Cast-to-Shape tool steel can help solve your production problems . . . or write Allegheny Ludlum Steel Corporation, Forging and Casting Division, Detroit 20, Mich.

For complete MODERN Tooling, call Allegheny Ludlum





Thirty-Ton Cranes Will Roll on These Sturdy Wheels

This is a part of the machine shop of Industrial Crane & Hoist, Ingersoll Products Division, Borg-Warner Corporation, Chicago. Those big double-flange wheels, weighing 408 lb each and made from Bethlehem's tough, rugged circular forged blanks, will be used on bridge cranes that the company manufactures. The cranes have a capacity of thirty tons.

Obviously, strength is the first requirement that the wheels have to meet. Another is durability (flanges and tread must be long-wearing). Still a third is overall quality to match that of other components in the big cranes.

The wheels score a bull's-eye on every count, for the husky Bethlehem blanks from which they are made are both forged and rolled in a single operation—a unique process that insures high strength and a well-forged structure throughout.

Bethlehem blanks have many applications in addition to crane wheels. They are widely used for spur, bevel, and herringbone gears; flywheels, sheave wheels, and industrial wheels; turbine rotors, pipe flanges, and many other circular products. Available in a wide choice of sections, the blanks range in size from 10 to 46 in. OD. They can be furnished heat-treated or untreated.

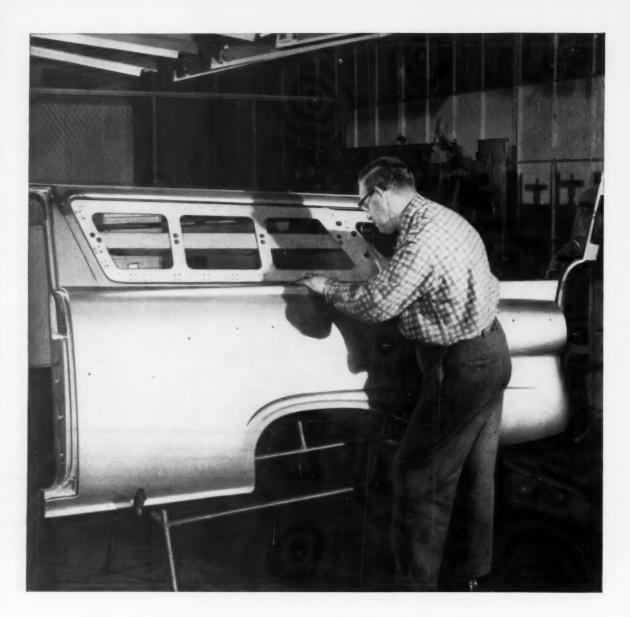
Our nearest office will gladly give you full details. Or ask for a copy of Booklet 216, which contains many pertinent facts and photographs.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation



BETHLEHEM STEEL



Lightweight magnesium fixture checks Ford station wagons

This magnesium checking fixture is used by Ford Motor Company in assembling Ford two-door station wagons.

It helps to maintain quality by checking the daylight opening relationship to the glass run channel and regulator retainer brackets in the quarter panel welded assembly. It assures accurate location of the glass run retainers and window regulator mounting holes. The fixture is dimensionally stable and has stood up well under continuous rough handling. One man can easily lift and

manipulate it with one hand.

Jigs and fixtures made with magnesium are always easy to handle because they weigh much less than steel or aluminum. Magnesium tooling plate is uniformly flat, low in cost and easy to machine, fabricate and weld.

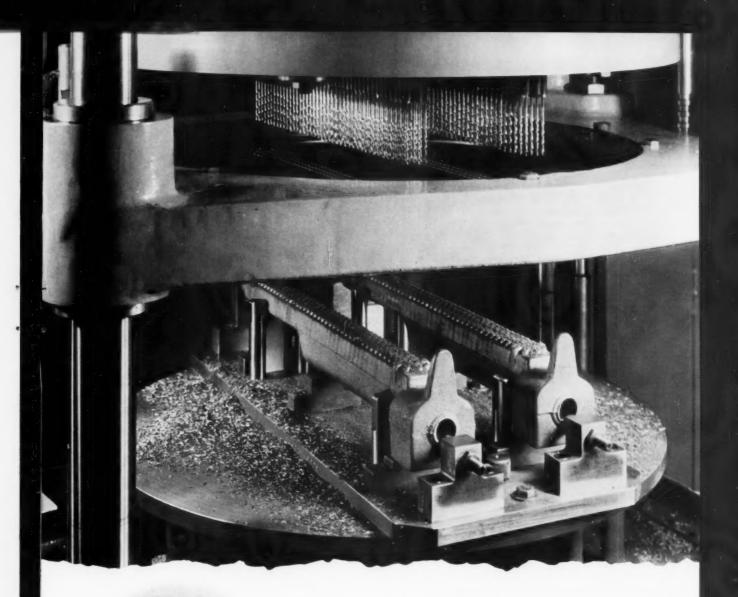
For the full story on magnesium tooling plate contact your nearest supplier of Dow magnesium or write to us.

THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1416Y-1.

AVAILABLE FROM STOCK AT: Copper and Brass Sales, Inc., Detroit, Michigan
Hubbell Metals Inc., St. Louis, Mo.
A. R. Purdy Co., Inc., Lyndhurst, N. J.
Reliance Magnesium Co., Los Angeles, Calif. Vinson Steel and Aluminum Co., Dallas, Texas.

YOU CAN DEPEND ON





Uniform quality
and high performance of
CLE-FORGE High Speed Drills
can help you reach
production quotas

COSTLY "DOWN TIME" REDUCED!

• You can keep your drilling operations on schedule with CLE-FORGE High Speed Drills. These fine quality tools give superior performance on every set-up... and you can rely on their uniformity day after day, month after month, year after year.

♦ Why not ask a Cleveland Service Representative for suggestions on reducing "down time" and increasing production in *your* shop? Contact our nearest stockroom, or . . .

TELEPHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR



THE CLEVELAND TWIST DRILL CO.

1242 East 49th Street

Cleveland 14, Ohio

Stockrooms: New York 7 • Detroit 2 • Chicago 6 • Dullas 2 • San Francisco 5 • Los Angeles 58

E. P. Barrus, Ltd., London W. 3, England

Sharp Clean Cuts EVERY TIME

Many thicknesses and sizes of metal are cut on this Steelweld Shear every day. Thanks to Steelweld's exclusive MICRO-SET knife adjustment, it is easy to set the knife clearance to the exact amount which will produce the best cut for every plate run through the machine.

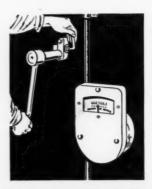
If desired, the knife clearance can be set for an average thickness and all plates cut without changing the clearance. This procedure is used with most shears because to change knife clearance on them is a tedious, difficult operation which usually puts a machine out of service for hours.

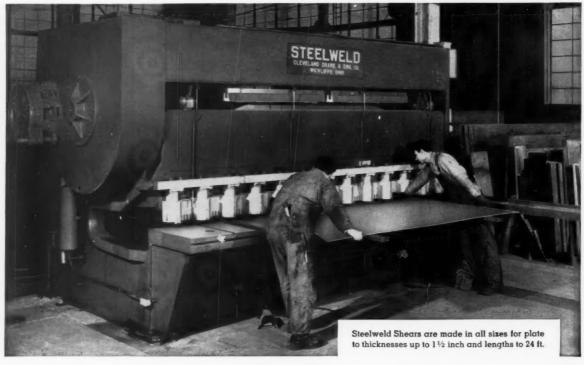
In contrast, knife adjustment on Steelwelds is made in a few seconds. It's simply a matter of turning a crank until an indicator points to the figure representing the thickness of plate being cut. No bolts to loosen; no parts to move. There is no need for using "average" knife settings.

The clutch and brake unit is another outstanding feature of Steelweld Shears. As it is air-operated, it is quick, snappy in action. Its low-inertia design assures cool operation, even after long continuous production runs, because energy to be dissipated is minimized and working pressure necessary on clutch and brake facings is greatly reduced.

The many features of Steelweld Shears make it worth your while to get all the facts.

Because of MICRO-SET Knife Adjustment







GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated,

THE CLEVELAND CRANE & ENGINEERING CO.

STEELWELD PINOTED SHEARS

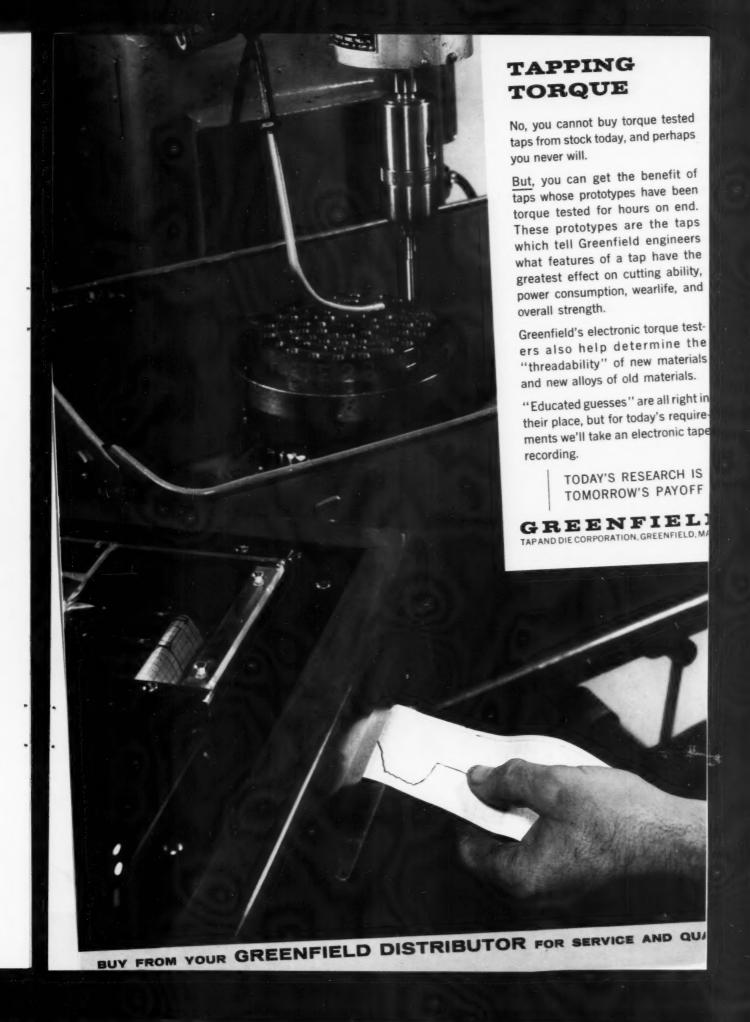




Photo courtesy of the Barber-Colman Company

THE LATHE — Hendey No. 2E 14" General Purpose Lathe

THE OPERATION — Turning and facing an aluminum component

THE CHUCK — Horton, of course

HORTON CHUCK DIVISION

Greenfield Tap and Die Corporation Windsor Locks, Connecticut



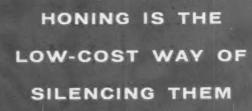
Call Your Horton Distributor Now!



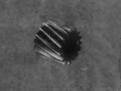
GEAR TOOTH NICKS and "HICKIES"

















You can hone the average automotive transmission gear in from 15 to 60 seconds. This single operation gets rid of all the noisy nicks and hickies that are so troublesome and tedious to deal with in any other way.

But that's not all. Red Ring honing also improves over-all surface finish—down to 2-4 microinches if necessary.

The initial pass under the honing tool is an effective inspection procedure in that it immediately reveals any distortions that may exist in tooth profile, spacing and pitch diameter runout. When such distortions are not excessive, honing corrects them.

If you want to reduce the cost of silencing noisy gears (1'' to 12'' PD), write for Bulletin H 57-2.



SPUR AND HELICAL GEAR SPECIALISTS ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORM

7810

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN . DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

OVER TWENTY YEARS OF

Onwill innovation and

SPECIALLY
DESIGNED
FOR
HIGH-SPEED
ALUMINUM
MILLING

● Everything Onsrud designs and builds...from machine tool components supplied to equipment builders to complete milling machines...everything from a 20 ounce high speed spindle to a 100 ton electronically controlled contour mill... is made for the specific purpose of milling ALUMINUM and related nonferrous metals. As you plan for new production or review your present methods and machines, if your objective is to find the means of reducing costs, be sure to let an Onsrud representative show you the ways Onsrud specialization can help you.

PROVED BY EXPERIENCE Onsrud has been a designer and supplier of production milling machines for the aircraft industry for over twenty years. Since 1945 Onsrud has developed a series of special high speed machines now in use in a variety of industries . . . all for the mass production milling of aluminum and other nonferrous metal parts.

A wide variety of

components are offered

to manufacturers

wishing to build their

components that are

also employed in

Onsrud designed and

built milling

machines. Typical

components include

own special machines

Onsrud today has successfully developed and built special electronically controlled milling machines for hyper-speed face, profile and contour milling involving three dimensional and three directional infinitely variable milling feeds.



ELECTRONIC CONTROL

SYSTEMS For control of speeds and feeds beyond the limits of mechanical systems and manual control ... and extension of production milling machine application to parts impossible to machine before. Designed and built as Selsyn follower, analog and digital systems.



HIGH SPEED

Built in capacities from 1 to 150 HP, for spindle speeds from 3,600 to 20,000 RPM. Air or liquid cooled for greatest possible sustained and intermittent overloads.



INVOMIL® ROTARY

MILLING HEAD

One of the most unusual milling head assemblies in the machine tool field. Provides infinite rotary feed of milling head through 3600. When mounted on gantry type carriage, in combination with conventional transverse and longitudinal feeds, provides infinite feed of milling head through any point on table.

FAMOUS ONSRUD FIRSTS

- · air turbine drives
- Metered Mist lubrication systems for high speed spindles
- water and air cooled high cycle induction drive motors
- InvOmil rotary feed milling head
- rotary table feed for automatic milling

HYPER-SPEED SPINDLES

Specially designed and built for the high rotational speeds of Onsrud motors. Assemblies equipped with preloaded bearings for precision end milling application. Dynamically balanced for vibration-free operation.



leadership to serve you...

When the parts to be milled are Alloys or related nonferrous metals

TYPICAL ONSRUD MACHINES NOW USED IN PRODUCTION MILLING

Onsrud A90-36 Automatic Contour or Profile Milling Machine with electronic and electro-hydraulic tracer Selsyn control system. For milling aircraft spar beams and other structural members. Reduces machine time and expands application. A precision machine for high speed automatic production.







Onsrud AA50-AE Rotary Feed Milling Machine, equipped with vertical head mounted on pivoted overarm. Follower on head assembly follows template as milling cutter reproduces template contour or line on work piece.

ONSRUD MACHINE WORKS, INC.

MACHINE TOOL DIVISION 7716 Lehigh Avenue Niles 31, Illinois









Flat Griddle, alumi. num alloy casting, 11" x 11½" x 9/16" high. Machine four sides and face of top rim in one setup. Production . . . two parts per minute.





Aluminum alloy carburetor part. Face mill two sides ... produc-tion four parts per minute minute.

Steam iron sole plate, aluminum alloy. Face milling operation six parts per minute.

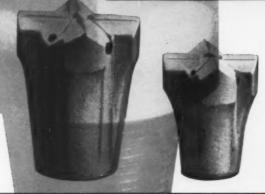


Onsrud offers components, standard machines, and machines Onstrue oners components, standard machines, and machines built to your production specifications... all for the super binds and machines william of alternative and making machines. built to your production specifications. . . an for the super high speed production milling of aluminum and related metals. May we invite your inquiry for complete information?

Bit manufacturer bites off

George P. Gaunt (right) shop superintendent shows rack bit to Joseph D. Grigas, industrial lubrication specialist at Standard Oil. Joe recommended switch to SUPERLA Soluble Oil. Joe is well qualified to make such recommendations. He has 13 years experience in such work, has a degree in engineering from Illinois Institute of Technology and is a graduate of the Standard Oil Sales Engineering School.











Brunner & Lay carbide insert rock bits are made from high chrome—nickel—moly steel, Rockwell 18C-22C hardness.

20% production increase

Superla Soluble Oil plus technical service add up to improved product output at Chicago Brunner & Lay Rok-Bit Corp.

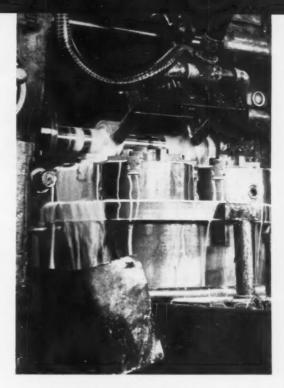
Superla Soluble Oil, which is now being used by Chicago Brunner & Lay Rok-Bit Corp., has solved a lot of milling machine operating problems for the Company. Soluble oils formerly used separated out of emulsion and turned rancid in use. Oil circulating lines plugged repeatedly. The plant's production rate was not up to capacity because of frequent shut downs for cleaning of machines and for unplugging of oil lines.

On the advice of Joe Grigas, Standard Oil industrial lubrication specialist, the Company thoroughly cleaned the machines, then converted them to Superla using the soluble oil at 10:1 dilution.

This is how the change-over worked out. Production was increased 20%. Machine down time was substantially reduced. The Company was sufficiently pleased with the performance of Superla Soluble Oil in milling machines to convert two grinding machines to this oil. Results obtained on the grinding machines: excellent wheel life, good finish and rust protection of work and machines.

Superla Soluble Oil emulsifies readily with all types of water. It is a stable oil and forms stable emulsions. It does not tend to develop objectionable odors in use nor is it injurious to men, work or machines. Superla Soluble Oil gives good tool life and prevents rust.

Get the facts about Superla Soluble Oil. Your Standard Oil industrial lubrication specialist has them. In any of the 15 Midwest or Rocky Mountain states, one of these lubrication specialists is nearby. Call the one nearest you. Or write Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Ill.



Milled slots up to %" wide and 1" deep are made in this special alloy Rok Bit Steel in one cut. All of these milling machines use SUPERLA Soluble Oil exclusively.

Quick facts about SUPERLA Soluble Oil

- Emulsifies readily
- Forms stable emulsion
- . Doesn't turn rancid
- Economical. Requires low emulsion concentrations
- Prevents rusting
- · Non-injurious to men, machines, work
- · Gives good tool life



STANDARD OIL COMPANY (Indiana)



HORIZONTAL AND VERTICAL

SHAPERS BUILT TO U.S. STANDARDS BY EUROPE'S FINEST CRAFTSMEN

The finest old world skills build life-long precision into these shapers assuring dependable production to the most exacting tolerances. Sound engineering standards and modern design are combined in these shapers offered at low initial cost.



5" VERTICAL



Chomienne Vertical Shaper-5" stroke, with 121/2" rotary table, automatic lubrication, power feed. A real time-saver for accurate machining of irregular shapes and forms. Low initial cost.

VMA Shapers-standard and production models . . 14" to 28" stroke . . automatic lubrication, table power rapid traverse.

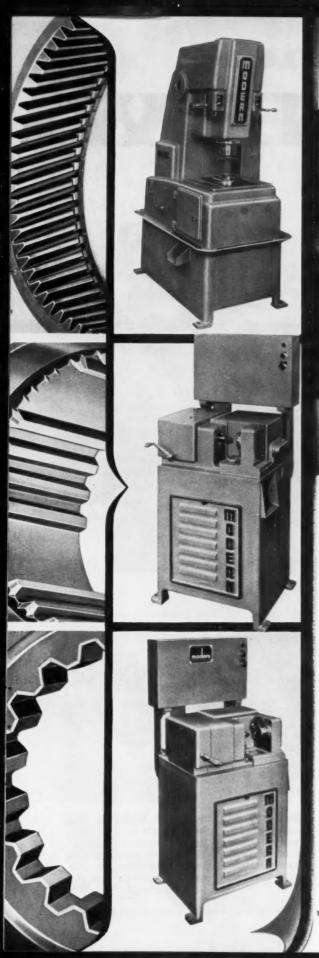


HORIZONTAL AND VERTICAL MILLING MACHINES . POWER HACKSAWS

FAST SERVICE AND PARTS AVAILABLE FROM MAJOR CITIES, WRITE FOR CATALOGS

110-MACHINERY, July, 1957

For more information fill in page number on Inquiry Card, on page 259





HOW **MODERN** CUTS THOSE HIGH DEBURRING COSTS

You know how costly removing burrs can be. **MODERN** can cut those costs for you—drastically and positively. **MODERN** Burr-Masters remove the burrs from all kinds of toothed parts—internal and external gears, splines, sprockets, clutches, etc.—leaving a smooth GENERATED chamfer over the entire contour.

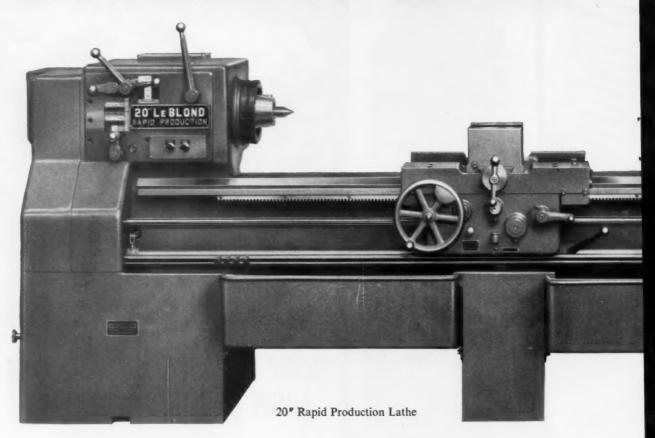
High productivity is a feature of all models, averaging five teeth per second.

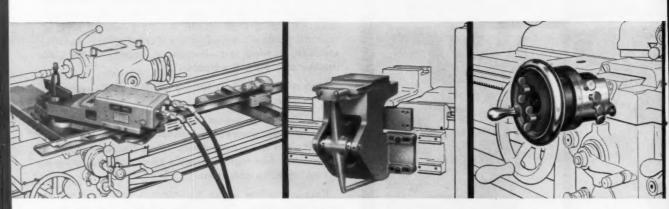
They chamfer-deburr so positively and so accurately that your engineers can now include dimensional deburr-chamfers on part prints and process sheets. Where functional chamfers are desired, Burr-Masters produce these while deburring—eliminating extra operations.

Here are a few of our Burr-Masters, and the types of parts they deburr. Chances are we have just the Burr-Master to suit your needs. Our sales department can provide you with complete details. Ask for a copy of Bulletin BM-156.

MODERN®
DETROIT 3
Pudustrial Engineering Co.

Another ALLNEW

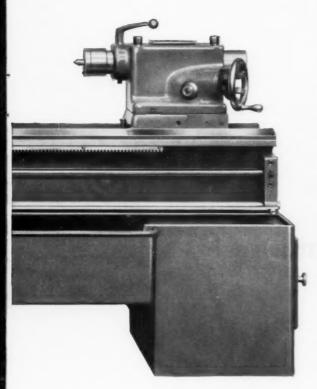




HYDRA-TRACE®. LeBlond's exclusive hydraulic duplicating attachment can be installed in minutes. For stepless form turning, contour facing, turning step shafts, etc. Transforms the Rapid Production into the most economical Tracing Lathe in its class!

Automatic Facing Attachment. Permits two simultaneous operations from front and rear. While straight turning with front tools, attachment faces automatically using rear tools. Multiple Positive Cross Feed Stops, Style B. Used for facing steps and duplicating diameter settings. Four adjustable stops are built into cross feed bushing. Will perform repetitive work accurately.

LEBLOND



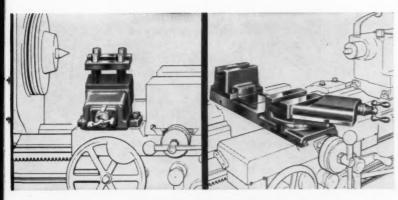
Low-cost manufacturing lathes with custom features to suit your specific turning jobs

Design your own manufacturing lathe—with the features and attachments you want. No extras to buy, only what you really need to do your job!

Here's how it works: The basic machine is either the new 17" or 20" LeBlond Rapid Production Lathe, designed from the ground up specifically for manufacturing assignments. They are not stripped down engine lathes. They are fundamentally simple, so that you can add the features you want. Ruggedly built, too, with all the basic LeBlond construction that assures dependable performance for many years.

From there on, it's your decision. First—your choice of speed ranges. On the 17", 70 to 700 rpm or 105 to 1050 rpm. On the 20", 57 to 600 rpm or 85 to 900 rpm. Next—your choice of any or all of these specific features: Hydra-Trace® hydraulic tracing, automatic facing, air-operated chucks, quick-acting tailstock, connected rests, taper attachments, turret tool post, cross and length stops, many more.

You'll find that with these custom features, you can design exactly the lathe you need to give you maximum production capacity per dollar investment. A lathe precisely suited to your manufacturing needs! Before you buy a manufacturing lathe, be sure to check the new LeBlond Rapid Production Lathes. Ask your LeBlond Distributor or write for Bulletin RP-220D.



Full Swing Rests. Makes full use of swing capacity over carriage wings for turning large diameter work. May be used with the compound rest for double-diameter turning on large gears, pulleys, etc.

Compound and Plain Connected Rest. Permits one-time set up for turning and facing step shafts. Rear facing tool operates alternately with front turning tool, without tool changing. ... cut with confidence



The R. K. LeBlond Machine Tool Company Cincinnati 8, Ohio

World's Largest Builder of a Complete Line of Lathes
For More than 70 Years

MACHINERY, July, 1957-113

For more information fill in page number on Inquiry Card, on page 259

How to win a make-or-buy

for production men

This Avey machine is used in a jet aircraft plant on the West Coast for drilling, boring, and spotfacing the flanges and periphery of a jet engine component.

The two Aveydraulic units mounted horizontally have 12" ram travel. The third Aveydraulic unit, mounted vertically, has 16" ram travel and a 6-speed gear box with a speed range of 150 to 1800 rpm. The vertical column has an in and out traverse of 20"; moves to a minimum of 15" and a maximum bolt circle of 55".

The 60" Electrodex table is equipped with a master index ring with two rows of bushings, 96, 49, and 8 indexes respectively. The three heads can be programmed to the indexing of the table.

Another example of how Avey combines standard units to meet special production requirements.

for management

Make-or-buy decisions are frequently close. Some of the questions you must ask yourself are:

If we decide to make . . .

What about indirect labor, plant space, supervisory time, and other overhead? Will we be merely spreading our overhead over a larger base? Or will we be increasing it? If we decide to buy . . .

Can our suppliers make a reasonable profit at a price that's right for us?

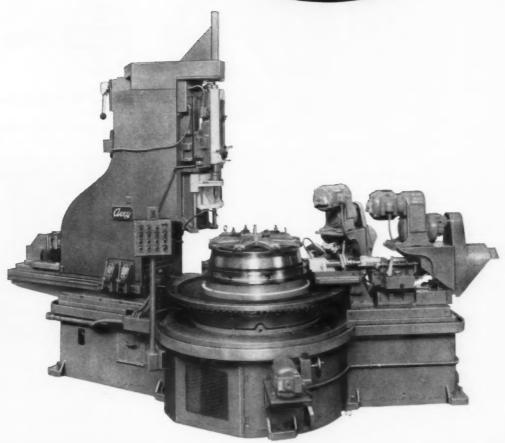
Whichever way you go, Avey production machines can help.

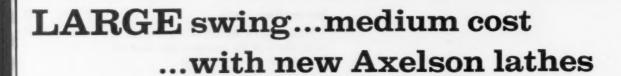
Put their high productivity in your plant, and their high earning rate will quickly justify your "make" decision. On the other hand, if your supplier is equipped with Avey machines, the chances are good that you can buy at a low unit cost and still feel comfortable about his profits.

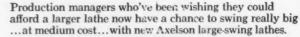
AVEY DIVISION, THE MOTCH & MERRYWEATHER MACHINERY COMPANY, BOX 625, CINCINNATI 1, OHIO drilling,tapping,production machines

decision









Axelson's 44", 48" and 60" lathes are ready to go to work on the job of producing profits from big, odd-shaped pieces that ordinary lathes can't handle.

Operators will take pride in the flexibility of these lathes, which can take on the biggest pieces in the shop... then swing quickly into action on smaller jobs. Big, healthy bites and small, precision cuts are all in a day's work.

Quick shifting of the 24-speed headstock produces spindle speeds from 6 to 750 r.p.m., forward or reverse, in true geometric progression.

Tailstocks are rugged one-piece castings that absorb the twist-turn punishment of heavy machining... eliminate inaccuracies caused by bolt stretch. Movement of the two-speed tailstock spindle can be fast or slow, easily controlled by the operator to meet his needs.

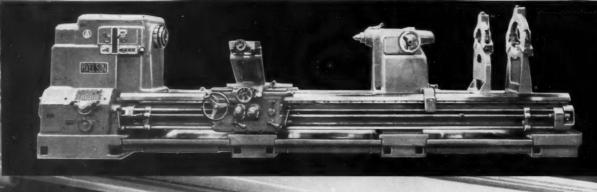
Two levers control all 81 feeds and 45 leads. Apron-located feed controls are positive-action, serrated-tooth type, requiring only light finger pressure for engagement.

For more information about these large-swing lathes ... at medium cost... call your nearest Axelson representative or write for Bulletins M7-5508 (44"), M7-5510 (48"), and M7-5509 (60").



AXELSON MANUFACTURING COMPANY

Division of U. S. Industries, Inc. 6160 S. Boyle Avenue, Los Angeles 58, California



Standard-Duty Model 6049 – 60" swing, 40 hp. (above) Standard-Duty Model 4836 – 48" swing, 60 hp. Heavy-Duty Model 4431 – 44" swing, 75 hp.



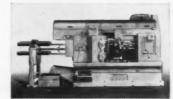


Models 25/8" LA, 31/2" AD, 5" KL, and 51/4" KR Conomatic Four Spindle Bar Machines are equipped with a number of quick job-change features. One of these is the all-position end attachment drive for the mounting of endworking opposed spindles in all positions, with independent feed to as many as three opposed spindles on a single setup.

Tool Slides

Another feature that is of considerable importance in tooling up is the radial screw adjustment of all sideworking slides. Trial cuts may be taken to correct diameters with form tools without changing the clamped positions of the form tool holders.

All Conomatic quick changeover models are equipped with dial adjustment of the working stroke of all tool carrying slides. Besides the Four Spindle machines there are three quick change Six Spindle models in $\frac{9}{16}$, 1" and $\frac{15}{8}$ " sizes. Write, wire, or phone for literature.



Conomatic

CONE AUTOMATIC MACHINE COMPANY, INC., WINDSOR, VT., U S. A.

Precision Requires Gages

THAT'S WHY FEDERAL OFFERS



Ideal for measuring difficult dimensions. Specially shaped arms of various

lengths can be designed to reach inaccessible spots or get around obstructions.

Just any gage is not good enough when you want to check a dimension for accuracy. Some dimensions require a higher degree of accuracy than others. And some dimensions cannot be reached directly. Still others need ranges or adjustments to give greater gage capacity.

Odd Shaped Jaws for Unusual Applications



Limitless variety of jaw shapes permit measurements impossible with any other type of gage.

HOLE LOCATION GAGES

Series 205 Gages provide for accurately checking hole location and concentricity. Also adaptable to applications involving hole and surface relationships.

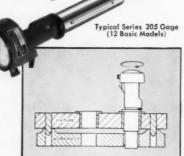


GAGES

Squareness and location of holes in three mating parts of pump housing are checked to determine alignment within 0001"



Two small and one large hole are checked for parallelism with each other.



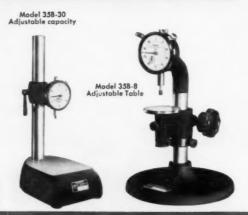
Hole location with respect to a predetermined reference and squareness of hole axis to a locating fixture.

BENCH TYPE THICKNESS GAGES and Small Comparators

Model 6918 — Deep throat for ample clearance. Weight for compressible materials, applied directly through Indicator spindle assures uniform meas-







to Suit the Job ...

SUCH A VARIETY OF GAGES!

It's easy to check a dimension with a Federal Gage - and it's the quickest and least expensive way. Just call Federal and get the right gage for your job.

FEDERAL PRODUCTS CORPORATION 7117 EDDY STREET, PROVIDENCE 1, R. I.

WHATEVER YOU NEED IN GAGES

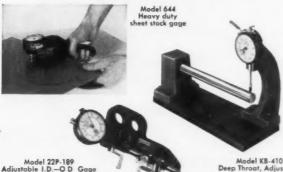
. Ask FEDERAL First



Model 22P -20 Deep Throat, Long Range

THICKNESS GAGES

Many styles and sizes, for portable and







Model 26P-7 Hand-grip

Model KP-120 Deep Throat, Portable



Model 1308-9 Electronic Ball Bearing Comparator. Detects one millionth.

OVER 10 TYPES OF COMPARATORS

Model 1208-1 Microset" Comparator 0" to 8"

Model 136 1.D. — O.D. Electronic Master Comparator Detects one millionth



MANY OTHER TYPES



Send for Catalog illustrating world's most complete line of Dial Indicator Gages.



HILL double housing **WAY GRINDER** for accurate grinding of V's, Flats and Angles

Substantial Savings (up to 50%) over previous methods.

Hill Hydraulic WAY GRINDER from operators side. Note convenience of all controls. Fully hydraulic table and cross-feed drive. 2 Independent spindle operation.

points worth considering

Rear view of HILL double bousing WAY GRINDER. Table width - 24" Table length - 72". Also built in other sizes. Complete details are given in Bulletin HWG.



5 Quick setting device for spindle heads.

3 Massive over-all construction.

4 Rapid traverse and fine feed

6 Convenient operator controls. 7 One-shot lubrication system.

Telescoping and tape way covers.

9 Magnetic chuck (optional).

adjustment.

10 Permanent Accuracy.



"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING THREADING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • "CLEVELAND" KNIVES • SHEAR BLADES



Cracked shaft in Valdosta... His job: get a new one down to Georgia by

tomorrow noon. It's an emergency case, but it's not as tough as it sounds.

He's backed by the press industry's largest parts department...by a million dollar parts inventory in two plants...by telephone and teletype tie-ups between Parts Headquarters in Hastings, Michigan and Toledo and local sales and service centers throughout the country.

Which is another reason why we say, "Bliss is more than a name...it's a guarantee."



E. W. BLISS COMPANY . Canton, Ohio

100 years of making metal work for mankind

PRESSES . ROLLING MILLS . MILL ROLLS. . DIE SETS . CAN MACHINERY . ORDNANCE

MSTRONG

Drop Forged CLAMPS



... in design, machining and strength; in completeness of line in both sizes and types.

Designs are based on a full knowledge of clamp uses and requisites. Drop forging assures die-perfect form, texture toughness and freedom from structural faults. Maximum stiffness is attained by a discerning selection of steels with accurate controlled heattreating, tempering and testing.

For dependability and long useful life, specify and standardize on ARMSTRONG Drop Forged Clamps.



Provide extra clearance required for some work. Extremely stiff for weight. Screws and hubs are accurately machined and aligned with ground seats; have sliding pin handles and free-acting swivel caps on point. Bodies have smooth sandblast finish. (11 sizes to 12" opening)



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HEAVY DUTY "C" CLAMPS

Universally recognized as strongest "C" clamps made. Longer hub holds screw alignment against terrific side strain; permit tighter clamping and multiplies thread friction against losening. Alloy steel screws are hardened at point to prevent upsetting. Ground seat. (8 sizes to 12" opening)



TOOL MAKERS "C" CLAMPS

Quality steels, drop forged, heat treated and accurately machined with ground seats. Drop forged screws have both "wing nut" handle for convenience and square necks for tight setting with a wrench. Either "plain" or "swivel" screw types. (Four sizes: 1", 2", 3" or 4" maximum opening)



MACHINISTS' CLAMPS



Jaws drop forged, carefully machined and hardened, are extra heavy; will not bend or spring on a short bite and are faced frue. Will grip non-parallel surfaces because the under face of the center screw is convex, fitting into a concave seat for tilting. (Four sizes: Capacities to 41/4" opening) Jaws drop forged,

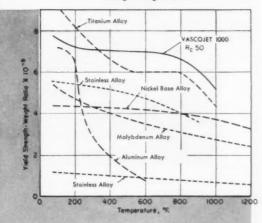
PARALLEL CLAMPS



Carefully machined from Carefully machined from selected grade steel and hardened. Particularly suited for holding work together when drilling or tapping. Rounded jaw ends increase clearance in close quarters. Spring clip holds loose pin in alignment while tightening or loosening. ing. (3 sizes: Capacities to $2\frac{1}{2}$ " opening).

1/18601131 1000 A new ultra high strength steel presenting the highest strength-to-weight ratio at elevated temperatures of any engineering material





Now available for aircraft, ordnance and industrial applications, VASCOJET 1000 is a moderately-priced ultra high strength alloy steel possessing extraordinary properties. This steel is stable to 1000°F, surpassing in strength-to-weight ratio the best titanium and hardenable stainless alloys. It is of great importance for super-speed aircraft structures and skins, high-temperature fasteners and rotors. VASCOJET 1000 in normal temperature service at strength levels of 260,000 to 290,000 psi has the toughness, transverse ductility, fatigue strength* and freedom from residual stress that make it ideal for heavy-duty applications. Typical among these are aircraft landing gear, air frames, engine mounts, arresting gear and other critical components; fasteners, springs, pressure vessels; truck, train, airborne and portable equipment parts. VASCOJET 1000 is available in plate, sheet, strip, bars, extruded shapes, wire and forging billets. Write for comprehensive technical data.

*highest of any material reported

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Precision Boring-Turning - Facing at LOW COST

Jones & Lamson fills a long-felt need with this new J & L Precision Boring Machine. Now, it is possible to have truly precise turning, boring and facing operations at truly low cost.

This new machine is ideal for long or short runs . . . is extremely versatile . . . is easy to set up . . . and spindle runout is less than .000020". Max. swing is 10" dia. and max. bore is 3" dia.

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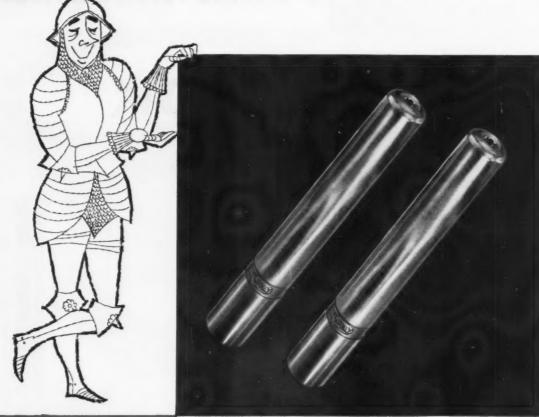
Base will accommodate two spindles for rough and finish boring, simultaneous facing and boring, or for bor-

ing two holes at once. Work table feed is actuated with variable hydraulic check unit. Adjustable stops are easily set for length of rapid traverse and feed strokes.



Push button cycling - manual or automatic.

NEW Microme chrome plated guide posts



ON NEW DANLY DIE SETS

Now standard on all Danly precision die sets, MICROME chrome plated guide posts typify Danly leadership in die set design. Years in development, they represent only a part of Danly's never-ending effort to provide the finest in quality. These new posts are extremely hard and have very high resistance to wear. Super smooth finish helps to guarantee lasting precision performance . . . they are another important reason why you should specify Danly die sets.

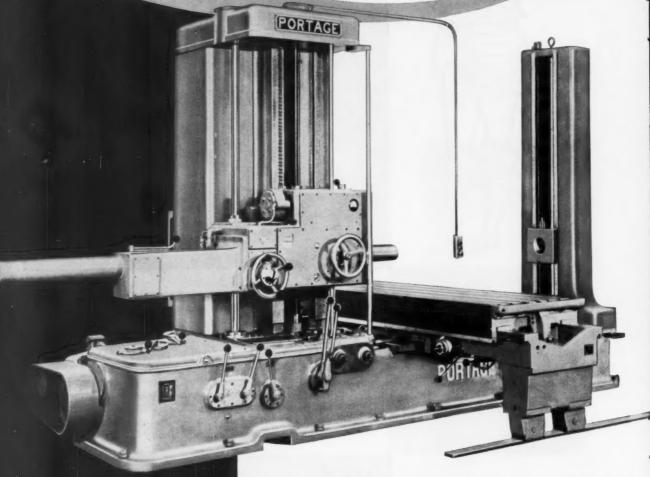
Leading industrial distributors and Danly branch assembly plants—located in all major tooling centers—stock Danly Die Sets for fast delivery.



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PORTAGE Announces...the

NEW LOOK



The new PORTAGE No. 4 Horizontal Boring, Drilling and Milling Machine has a complete NEW LOOK. A heavier base, column, saddle and head are a few of the new features. The overall "beefed up" machine offers a wider range of versatility. NOW... you can handle the larger work ... with the smallest possible capital investment. Write for complete information.



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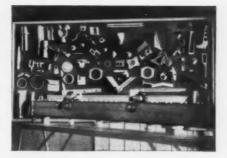
Representatives in Principal Cities

BUILDERS OF PRECISION MACHINE TOOLS, SPECIAL AND PRODUCTION MACHINERY SINCE 1916



◆Aerocycle, a one-man helicopter now being tested by the U. S. Army, is one of the many aircraft for which Aeroaffiliates machines precision parts.

Some Examples of Aeroaffiliates' Work. All require fine tolerances and excellent finish. All were made with the help of Cities Service Chillo Cutting Oils.





"Fine Tolerances! Excellent Tool Life! With Cities Service Chillo Cutting Oil"

In probably no other machining operation are the tolerances so fine, the requirements so demanding as in aircraft work . . . especially when it's for the U. S. Army or Air Force.

But it is on such work that Aeroaffiliates, Inc. of Fort Worth, Texas, has become famous.

Every day, Aeroaffiliates employees must work with tolerances as fine as .0001, and their products must have an unusually good finish...so good that they are measured by a special gauge before the aircraft industry will accept them.

Obviously, this could play havoc with tool life

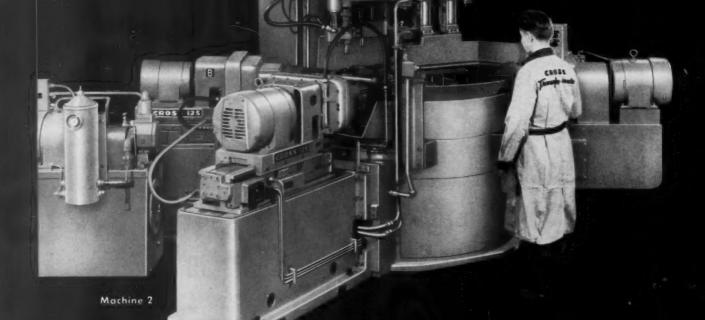
... "but thanks to Cities Service Chillo Cutting Oils, tool life and finish are the best ever," says Aeroaffiliates. "These cutting oils are equalled only by the help we receive from the Cities Service Lubrication Engineer, a man whose knowledge and help we greatly value."

Whatever your type of machining operation, there's a Cities Service cutting oil tailored precisely for it... and a Cities Service Lubrication Engineer to help you choose it. Call him in this week. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.



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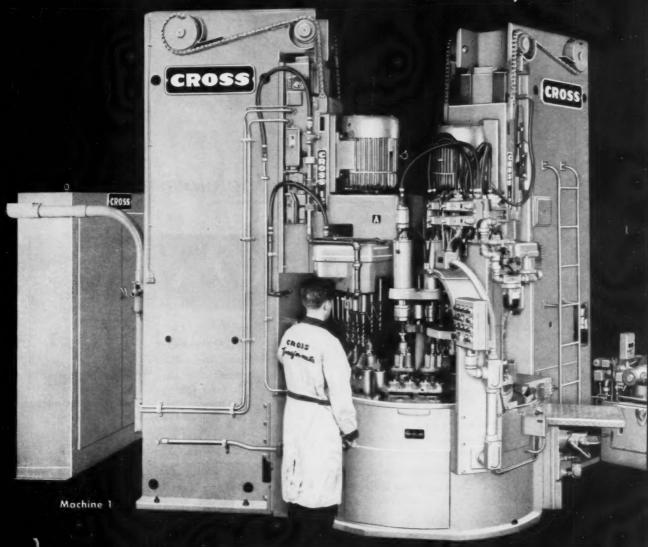
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More Specials by Cross



- * 800 pieces per hour at 100% efficiency.
- * Four parts machined in each station.
- Machine 1 drills and reams rocker shaft hole; forms oil groove; drills one oil hole. Machine 2 drills, chamfers and taps adjusting screw hole; drills, counterdrills and spotfaces second oil hole.
- * Push button controlled power wrenches operate fixture clamps.
- Cross "building block" construction provides flexibility for part design changes.
- ★ Complete interchangeability of all standard and special parts for easy maintenance.
- ★ Other features: Construction to JIC standards; hardened and ground ways; hydraulic feed and rapid traverse for drilling and reaming; individual lead screw feed for tapping; automatic lubrication; pre-set tooling throughout.



producer of the original low hung drive

Check this exclusive combination of Carlton advantages:

Low hung drive: created by Carlton, widely copied but never duplicated.

Wide selection: 5 models and many arm and column sizes.

Greater capacity: broad range of speeds and feeds; practically any combination of tap leads available.

Programming, pre-selector, partial pre-selector or manual speed-feed control.

Super-precision column clamp; 360° clamping for 20% more rigidity, greater accuracy.

3-unit power clamping: arm, head and column, for easier and more economical operation.

Positive tooth feed clutch: provides constant feed to the spindle regardless of density of metal.

Easy,economical maintenance: only one friction clutch; 100% interchangeability of parts.



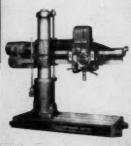
A versatile radial drill with hole drilling range from 1/8" to 134" diameter. Offers



many of the exclusive Carlton design, construction and operating advantages shown at left.



A medium duty radial drill with a hole drilling capacity of 1/8" to 21/4" diame-



ter. Like all Carlton radial drills, the 1A has the super-precision column clamp and the anti-friction mounted head.

Model	Column	Arm lengths	No.	Range	No.	Feeds Range	Motor recommended
OA	9"	3'-4'	9	20 to 1	4	.006020	3-hp
1A	9* 11*	3'-4' 3'-4'-5'	12	25 to 1	6	.006025	5-hp 5 or 71/2-hp
3A	13" 15" 17"	4'-5' 4'-5'-6' 5'-6'-7'	36	100 to 1	18	.004125*	7½, 10, 15 or 20-hp
4A	19"	6'-7'-8'	36	100 to 1	18	.004125*	15, 20 or 25-hp
5A	22" 26"	7' to 10' 8' to 12'	36	100 to 1	18	.004125*	20, 25 or 40-hp

^{*8,} $11\frac{1}{2}$, 14 and 18 threads per inch are standard, with various other combinations available.

presents the modern design radial drill

presente the modern design radial artic

The 3A, 4A and 5A Carlton radial drills offer you a choice of four speed-feed controls:

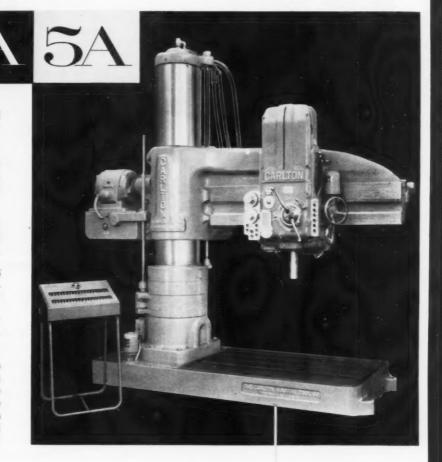
Programming for pre-selecting speeds and feeds for an entire drilling program including as many as 20 or 30 operations.

Pre-selector for setting speed and feed for the next operation while machine is still under cut.

Partial pre-selector selects 36 spindle speeds; feeds shifted manually.

Manual to take advantage of Carlton's centralized push button control.

In addition, these three models give you all the exclusive Carlton advantages shown on the opposite page. No wonder leading machine tool buyers say that Carlton is the ONE modern design radial drill. The Carlton Machine Tool Co., Cincinnati 25, Ohio.

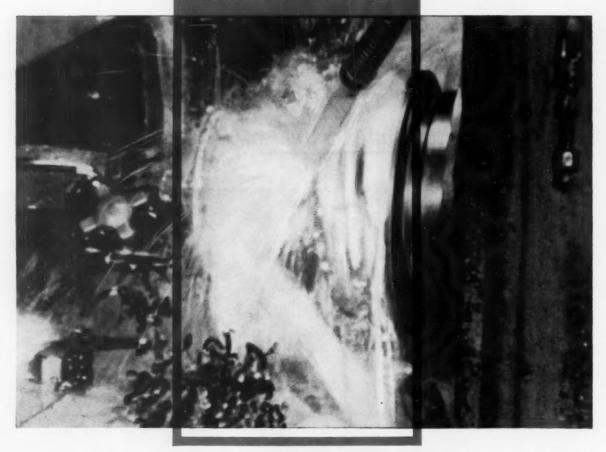




SPECIALISTS IN RADIAL DRILLS

HOW TO KEEP PARTS

RUST-FREE



... and avoid costly rejects

Where a soluble oil emulsion is required for machining precision parts, depend on Texaco. For *Texaco Soluble Oil* emulsions contain an extremely effective rust inhibitor which safely protects all surfaces. Better finish is assured.

Texaco Soluble Oil emulsions remain stable, which means cutting efficiency stays high under all conditions. Tools last longer—give greater production between regrinds. What's more, operators like the way Texaco Soluble Oil emulsions keep their machines clean, with far less maintenance.

These are good reasons for machining with Texaco. There are many others. And there is a complete line of *Texaco Cutting, Grinding and Soluble Oils* to help you do a better, faster job, at lower cost. A Texaco Lubrication Engineer will be glad to help you select the proper ones for your applications. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, New York.



- Missile Program Massive
- Operation Thermal Thicket
- Operation Hades
- Washington Briefs



Keeping up with Washington

By Loring F. Overman

BECAUSE of the guided missile, industry is being asked to take a new look at the defense program. Defense chiefs are pointing out that military science, having progressed from surface to atmosphere, is now ready to move on into the stratosphere. For the machine tool industry—progenitor of industrial equipment and military materiel—the change-over can again be revolutionary.

Major adjustments will come first in the aircraft industry. Authority for this forecast is Major General David H. Baker, Director of Procurement and Production, Air Materiel Command. General Baker expects deliveries of airframe and missile frame weight to total 6.5 million pounds per month by the end of 1957 . . . dropping to 2.5 million pounds per month by the fiscal year 1959-1960. At that leveling-out point, the shift to missiles should be about complete.

Surplus space in aircraft plants, accompanied by surplus facilities and surplus workers, will result. The change will also affect companies that manufacture current model engines and other specialized equipment, as well as the machines which produce these units. Projection of industrial thinking, to anticipate these leveling-off problems and to be ready with solutions, is the General's suggestion.

Operation Thermal Thicket

Many of tomorrow's defense production problems are being previewed through projects of the Manufacturing Methods Branch, Industrial Resources Division, Air Materiel Command. By means of pilot projects under contract in several fields, the Air Force is seeking solutions to problems of high-heat metals, electronics, materials fabrication, machine tools, processes, and plastics. Temperature-resistant metal projects have a high current priority. Included are studies of manufacturing methods involving alloys of titanium—titanium casting, forging, and extrusion. Machine tool projects deal principally with developing and improving machines to handle the new and harder metals that will be specified for aircraft and missiles now in the drafting stage.

Operation Hades

Despite progress being made by the Air Materiel Command, aircraft industry spokesmen are pressing other government researchers for answers to the problems of "hot metal." The Office of the Assistant Defense Secretary for Research and Engineering has been told that metals capable of withstanding temperatures of from 2000 to 3500 degrees F. must be anticipated by 1967. The Aircraft Industries Association has named half a dozen fields where a great deal of research and development activities

are needed. Involved are machines to fabricate the new materials, special instruments, strain gages, high-energy heat sources, better refrigeration units, skin cooling methods, engines, fuels, and electrical equipment.

Machinery Outlook Studied

Although concerned over unique problems of a new defense age, the Department of Defense still appreciates the importance of keeping today's military muscles strong. Congress learned in mid-May that the mobilization program no longer emphasized expansion of facilities in an emergency. Instead, the Department is endeavoring to maintain production facilities in a constant state of readiness and adjusted to technological changes.

About machine tools, the DOD report to Congress observed: "In order to improve management of its machine tools in peacetime and to provide more accurate data for mobilization planning, the Department of Defense has undertaken a detailed inventory of the metal-working equipment owned by the military departments. Of the 350,000 pieces currently estimated to be held by these departments, 280,000 have been inventoried, having an acquisition value of approximately 3 billion dollars. The inactive equipment totaled 64,000 pieces on June 30, 1956."

Washington Briefs

- Congress has been asked to consider a joint Senate-House resolution to set aside not less than 25 per cent of Defense Department prime contracts for small business firms. Senator Sparkman, Small Business Committee Chairman, noted that small business received 25.3 per cent of defense contracts in 1954; 21.5 per cent in 1955; 19.6 per cent in fiscal 1956; and only 16.7 per cent in fiscal 1957.
- The Senate Armed Services Committee has asked the Secretary of Defense to "do something" about former government employes who accept employment that puts them in a position to influence the placement of defense contracts. A subcommittee report said that 108 former officers holding ranks of brigadier general, rear admiral, and above have received security clearances that permit them to represent their companies or perform duties in connection with defense work.
- The Senate, in mid-May, passed and returned to the Senate-House conference committee, a Department of Commerce appropriation bill that restores the money needed to operate twenty-five industry divisions of the Business Defense Services Administration. The House had cut out this item in trimming the Commerce Department estimate of requirements for fiscal 1958.

Means HIGH SPEED

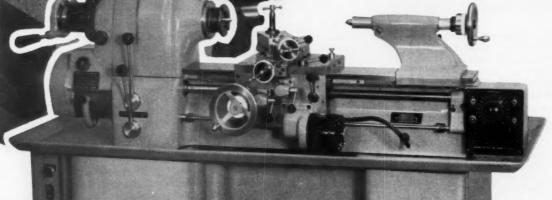
PRECISION TURNING

for

THE AIRCRAFT INDUSTRY WITH "THE OUTSTANDING TOOL ROOM LATHE"

> HARDINGE Model HLV **Tool Room Lathe**

Write for Bulletin HLV



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HARDINGE BROTHERS, INC., ELMIRA, N.

Aircraft Building— An Eight-Billion-Dollar Industry

FEW industries have had as meteoric a rise as the aircraft industry. In 1909, only one military plane was built. Figures are not available as to the number of civilian planes built that year, but they were few indeed, as only twenty-nine were constructed three years later when sixteen military planes were turned out. Contrast this low production with a total of 96,318 planes, all military, in 1944, which hit the all-time production zenith.

The number of planes to be built this year will be considerably smaller than the all-time high, say, approximately 12,000 to 13,000 planes. But there is a vast difference in the size and weight of aircraft today in comparison with the fighters, bombers, and transport planes produced at the end of World War II. For example, in 1944, heavy bombers had an airframe weight of 49,000 pounds; today, 170,000 pounds. All-weather fighters weighed 10,000 pounds; today, from 12,000 to 20,000 pounds. Heavy transports weighed from 20,000 to 60,000 pounds; now, up to 111,000 pounds. In addition to planes, the aircraft industry is today heavily engaged in turning out guided missiles.

The total sales of aircraft in 1957 will amount to over \$8,000,000,000, and similar amounts of business can be anticipated for the industry in the years immediately ahead. Business conditions, therefore, are not a mat-

ter of concern. The problems are those of originating airplane designs to keep pace with changing scientific concepts, of producing materials that will meet the new concepts, and of developing processes for machining and fabricating the new materials. There is, of course, today's omnipresent problem of finding a sufficient number of scientists, engineers, and qualified production men to carry out projected programs.

Manufacturing processes in the aircraft industry undergo more fundamental changes year after year than have probably occurred in any other industry in the same span of time. This is obviously due to the rapidly changing ideas about aircraft design. First, wood and fabric planes with comparatively simple water-cooled engines; then all-aluminum airframes and the complicated piston type air-cooled engines; and now, planes constructed of metals that withstand the stresses and temperatures of supersonic high-altitude flying—planes equipped with jet engines.

That the aircraft industry has always been capable of solving its production problems has been indicated by the many articles published in MACHINERY since the first Aircraft Production Number was published in 1938. The present special number continues to prove in the following pages that the production men of the aircraft industry are really "on their toes!"

Charles O. Herb

Machining Costs Cut 25% by switch to NEW RYCUT 50



Logan Engineering Co. report shows how you can save up to 30% with a Ryerson leaded alloy

THE PROBLEM—This Chicago manufacturer of precision lathes faced a tough production problem from a time and cost standpoint. Lathe spindles have to be tough and hard with high wear resistance—so the steel Logan originally used was SAE 52100.

But the spindles were turned down and center-drilled from the solid to hole sizes as large as 1% ". And ID's had to be accurate and free from scoring along the entire length of the spindles. 52100 provided the required mechanical properties but was slow cutting and created production difficulties and a high scrap rate.

Needed: A free-machining steel that would develop the high hardness levels, the toughness and wear strength required for the application.



THESE LARGE ALLOY STOCKS . . . also carbon and stainless steels in every shape and size, are in stock at Ryerson. Also call Ryerson for reinforcing steel service, industrial plastics, machinery and tools, etc.

THE SOLUTION—Logan engineers had long been on the lookout for a steel that would solve their production problems so they were eager to try New Rycut 50 when this Ryerson 50-carbon alloy steel with a controlled lead addition was suggested by Ryerson metallurgists.

New Rycut 50 was a success from the start! Now, after two years, Harry Peterson, Logan plant superintendent, reports: "New Rycut 50 has saved us a consistent 25% of our former costs in the production of lathe spindles. Rycut's uniform machining and hardening properties have reduced scrapped parts to a minimum and the steel has proved satisfactory in every way."

This is just one of many case histories in our files on the steels in the Rycut series—New Rycut 50, Rycut 40 and Rycut 20. Actual performance records show machinability increased as much as 50%...tool life lengthened as much as 300% when a Rycut steel is used in place of a standard alloy of comparable mechanical properties.

To get further information on these great new cost-cutting steels or for quick shipment of any steel requirement, call or write your nearby Ryerson plant.

RYERSON STEEL

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK * BOSTON * WALLINGFORD, CONN. * PHILADELPHIA * CHARLOTTE * CINCINNATI
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Convair F-102 All-Weather Interceptor

TH PRODUCTION NUMBER

Vol. 63 No. 11

MACHINERY

July 1957





THE AIRCRAFT INDUSTRY'S FANTASTIC FUTURE PROBLEMS

ILITARY necessity rather than consumer preference has generally dictated the direction taken in aircraft construction. Up until 1950, manufacturing capability in the industry was well ahead of engineering design. The shop could build anything that the engineering department conceived. But, at "MACH 1" (the speed of sound), high-density materials, sturdier and stiffer structures, exactingly close tolerances, and complicated electronic equipment became production necessities. From that point, two roads-one marked "Engineering Capability" and the other, "Manufacturing Capability"-have diverged until today the engineer's cherished desire for complete freedom of design is fettered by the ability of the aircraft plant to turn out the product.

As engineering capability gained ground faster than manufacturing capability, productivity has lowered. More and more people are required to build the products that the military services are demanding and the engineers are designing. With the advent of the modern weapon system and its attendant electronic complexity, engineering technology has increased fantastically. This is best dramatized by the fact that today the aircraft industry has approximately one engineer to every seven other employes. Ten years ago, the ratio was one engineer to sixteen other employes.

Until fairly recent times science and industry had a rather loose relationship. But, progress in many industries has been so swift and has carried so far into the frontiers of human knowledge that the union of science and industry has become both inevitable and inseparable. Congress appropriates billions of dollars annually just for research and development to assist and stimulate the aircraft industry's quest for ever greater technological development to meet national defense needs. Much of this money goes for advanced work on such top-priority projects as intercontinental and intermediate-range ballistic missiles, supersonic and hypersonic aircraft, and airplanes powered by nuclear energy.

Today we are talking seriously about bombers and fighter type aircraft that will travel at four times the speed of sound. They would cruise at a height of more than 50,000 feet for as many as 200 hours and have new types of propulsion. Under such conditions, atmospheric friction alone would heat the aircraft's external skin to around 800 degrees F.

In not too many years, we will probably be building planes to operate at *six* times the speed of sound—at an altitude of 35,000 feet—that is about 3700 miles an hour. Although the temperature of the atmosphere above 35,000 feet is minus 67 degrees F., planes flying at "MACH 6" for as long as fifteen minutes must be built to withstand outside skin temperatures of 3000 degrees F. To launch a satellite beyond the pull of gravity, it is predicted, an escape velocity of more than thirty times the speed of sound must be developed.

To bring such incredible performances within the realm of possibility, scientific laboratories must discover or create new materials because the substances in common use today would not



By

GENERAL JOSEPH T. McNARNEY, USAF (Ret.)

President, Convair Division General Dynamics Corporation San Diego, Calif.

withstand environmental temperatures that in the future may range from as low as minus 450 degrees F. to as high as 60,000 degrees F. Temperature extremes are not the only problem. Scientists of today are concerned also with the ionization and nuclear deterioration of structural materials.

Limitations in the strength of materials are not the only difficulties that must be surmounted in this coming age of fantastic speeds and staggering distances. Dimensional and metallurgical tolerances will of necessity be microscopically close.

Clearly, we must find new methods of achieving this kind of precision in parts shaped from difficult-to-handle materials like titanium, high-temperature steels, ceramics, and combinations of ceramics and metals. Machine tools and manufacturing processes must be developed for working such materials adequately.

As the technical limitations imposed upon our facilities are extended by new materials, the men responsible for designing new products will be forced to re-examine their traditional engineering concepts, in order to make maximum effective use of new substances and ideas. Projects as technically advanced as some of those mentioned are already making formidable demands upon the scientific and engineering knowledge of our most highly trained people in the fields of electronics, metallurgy, aerodynamics, thermodynamics, propulsion, and human factors. Scores of projects that were beyond our wildest dreams fifty years ago no longer seem impossible to attain and are being pressed with all possible urgency today.



September 1945, he became acting supreme al-

lied commander in the Mediterranean Theater

of Operations, and the following December suc-

ceeded General Eisenhower as commanding gen-

eral of the United States Forces in the European

Theater and commander-in-chief of the United States Forces of Occupation in Germany. Among

other important assignments after returning to

the United States, he was commanding general

of Air Materiel Command at Wright-Patterson

Air Force Base, Ohio, from October 1, 1947, to

September 1, 1949.



THE PLANT BEHIND A FAMOUS POWER PLANT

By EDGAR ALTHOLZ
Associate Editor

At North Haven, Conn., United Aircraft Corporation's Pratt & Whitney Aircraft Division has concentrated machining activities for its jet engines.

ONTINUING heavy military and commercial demands for jet aircraft require the engine manufacturer to preserve his traditional role in the vanguard of machine tool technology. Engineering changes in parts and materials—vital to air superiority—frequently are contingent on the development of suitable machine tools or machining techniques. More often than not, this development is a joint effort of the machine tool builder and the aircraft engine plant. At the big Pratt & Whitney Aircraft installation at North Haven, Conn., there are many unusual examples along the production lines of this collaboration between the machine tool builder and the machine tool user.

This plant, a modern structure, has recently been enlarged and now contains 1,000,000 square feet of manufacturing space. Originally, the company's piston-engine work was centered here, but

140-MACHINERY, July, 1957

today, better than 75 per cent of the space is devoted to machining operations on parts for

J-57 and J-75 jet engines.

In Fig. 1, the hub of a front compressor rotor is being finish-turned. The work surface is a conical web in the form of a deep annular recess, all of which is reached by one single-point tool. Equipment consists of a 32-inch Axelson crosscenter lathe having a Voss-Raytheon electronic tracing unit mounted as a compound on the cross-slide. Two templates are fixed on the carriage saddle, each representing one-half of the conical shape.

To machine the inner half of the cone, the lathe operates in a conventional manner, with the tracer stylus guided against the front template, as is being done in the illustration. Then, to machine the outer half, the spindle rotation is reversed, and the carriage momentarily retracted while the cross-slide is run to the rear. With the carriage again advanced, the stylus now operates

against the back template.

As the cross-slide feeds over the saddle, the stylus directs a sensing head to signal a control panel to advance, retard, or reverse the tracer motor. This motor drives the screw of the compound rest. The lathe itself is powered by a 30-hp, constant-torque, direct-current motor through a Reliance variable-speed drive. By means of a cam on the cross-slide, a rheostat raises or lowers the speed of a generator set, and thus varies the spindle speed to maintain a preset cutting speed as the tool approaches or moves away from the lathe center.

Shuttles Locate Airfoils for Initial Machining

Blades and vanes are high-production, precision items for the jet-engine plant. Each stage of the engine requires its own blade and vane design. They are of various materials—stainless steel, Stellite, or titanium—and originate as castings or forgings. End areas, called buttresses, require exacting machining to permit proper assembly in the shrouds. Because of the precise curved configuration of the airfoil, a special holding means is required.

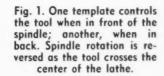
This consists of supporting the airfoil in a small open-end iron box, or shuttle, which has locating pads machined on all outside corners. To position the blade or vane correctly in the shuttle, a special duo-lens optical comparator is used; then a low-melting point alloy (Cerrobend) is poured around the airfoil section, and on solidifying secures the part. Initial machining of the buttresses is done with the part in the shuttle. Later, the shuttle is immersed in hot

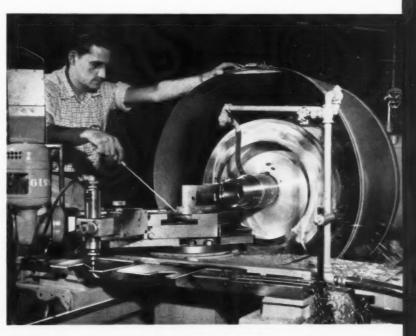
An initial operation on the vanes is shown in Fig. 2. Here, concave and convex surfaces and leading and trailing edges of the large (outer) buttress undergo stock removal by broaching. The equipment is one of a battery of seven Colonial 15-ton, horizontal surface broaching machines. There are two rows of broach-holders carried on the machine ram.

water to melt the alloy. The work is then held

in various fixtures for finishing operations.

On the operator's left is the work-fixture slide,





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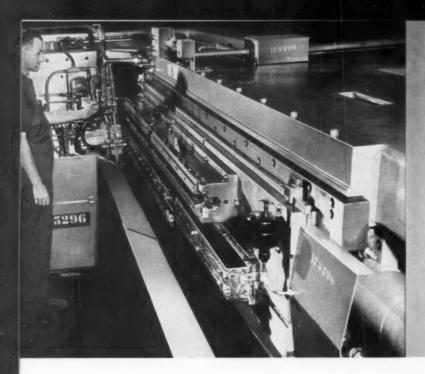


Fig. 2. (Left) In the first work position, the vane is in line with the upper broach-holder row. Meanwhile, another vane, shifted 90 degrees, is in the second work position, in line with the lower broach-holder row.

Fig. 3. (Below, left) In each milling cycle, two vanes are loaded at one station, semi-finished at the second, and finished at the third.

Fig. 4. (Below, right) Inner surfaces of the vanes are ground radially by the 45-degree head; outer surfaces, by the perpendicular head.

at right angles to the movement of the ram. Two shuttles are handled simultaneously, one in line with the upper broach-holder row, and the other, with the lower row. In successive cycles of the machine, the shuttle in the top position on the work-fixture slide is shifted 90 degrees and installed in the bottom position, and a new shuttle is installed in the vacated top position.

Broaches in the upper row cut the buttress to

width, and those in the lower row generate the special profile. Shuttles are clamped automatically, and the work-fixture slide advances toward the ram until the buttresses of the vanes intersect the paths of the broaches. Movements of the fixture slide and broach ram are synchronized: When the slide is forward, the ram executes its broaching stroke, the slide then retracts, and the ram returns to its starting position.





Vanes Climb-Milled on Dial Type Machine

The leading edge of the vane outer buttress is machined on a Snyder three-station vertical mill, Fig. 3. Two vanes are handled at a time. One station is for loading, one for semifinishing, and one for finishing. At each of the two work stations, a vertical head supports four gang cutters which straddle the work.

Vanes are held in air-clamped fixtures, spaced around a horizontal table. Indexing—120 degrees each cycle—is automatic. The heads are fed down pneumatically, and the cutters climb-mill the surfaces.

Since broaching produces a buttress profile which is in a straight line, it is necessary to finish inner and outer surfaces of the leading and trailing edges so that they are radial. The operation is performed on Frauenthal double-head grinding machines. One of them appears in Fig. 4.

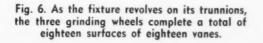
Twenty-two to twenty-eight vanes (now removed from their shuttles) are located around a circular fixture on the work-table. The left-hand spindle, at an angle of 45 degrees, grinds the inner surface, and the right-hand spindle, at 90 degrees, the outer surface. Both spindles operate simultaneously, grinding to a spark-out. For unloading and reloading, the spindles retract vertically.

The illustrated machine is one of a battery which grind the trailing edge buttress of the vanes. A second battery of these machines grind the leading edge buttress in a similar setup.

Form Grinding Centered Around "Ferris Wheel" Fixture

An entirely new approach to vane processing—finish-grinding all eighteen surfaces of the buttress directly from the "rough" after qualifying surfaces are established in the shuttle—is already producing remarkable savings in time and material. Developed by P & W A's production engineering department, the method consists of grouping eighteen vanes on a "Ferris wheel" fixture which revolves between three form-grinding heads. One wheel completes the vane periphery; the second, the leading edge buttress; and the third, the trailing edge buttress. The grinders operate in unison and finish all surfaces of all vanes in a twelve-minute cycle.

In Fig. 5 is a view of the fixture being loaded, and in Fig. 6, a view of the equipment (con-



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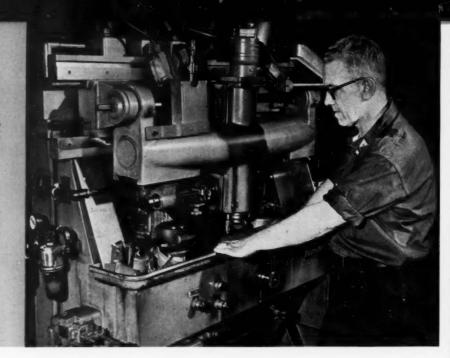


Fig. 5. Loading the "Ferris wheel" fixture for the form grinders. A second, identical fixture is in work, so that production is continuous.



Fig. 7. (Right) The work-fixture carrier pivots toward or away from the belt, maintaining a continuous contact with the curved airfoil.

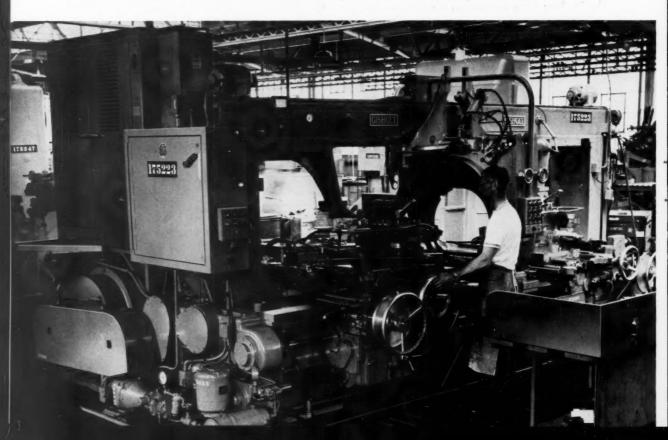
Fig. 8. (Below) Designed expressly for facing the compressor discs of a jet engine, the center-drive lathe rotates the work between two conventional carriages.



structed by Ex-Cell-O) with the fixture in position for grinding. Actually, there are two fixtures, one being unloaded and reloaded while the other is in operation. One side of the fixture, not visible, carries a face gear. When in operation, the fixture revolves on integral trunnions and is driven from a separate power source by a pinion which engages the face gear.

Before being loaded, vanes are prepared with a center hole in the small buttress and a locating point along the trailing edge side of the buttress. Fixture stations have a center which enters the hole and secures the vane by thrusting it outward. There is an overhead track by which the fixtures are transferred to the grinders from the loading rig.

Each grinding head is a self-contained unit, having its own spindle drive, wheel-slide, and diamond truing device. Wheels cut on their periphery and are automatically compensated for wear. Grinding is performed to a time cycle, and accuracy is held within 0.001 inch. With all surfaces finished together, out-of-tolerance rejects have been virtually eliminated.



Pivoting Carrier Keeps Airfoil Against Belt

The final curvature of the vane shroud end, not yet machined, is produced by stropping on a Pratt & Whitney airfoil grinder. In Fig. 7, second-stage nickel-alloy vanes are being stropped. Held in a horizontal position, the vane revolves slowly against a 50-grit belt running at 1800 surface feet per minute. To keep the airfoil in contact with the belt, the work-holding fixture is supported from a carrier which is free to pivot from front to rear. A profile cam, also suspended from the carrier, revolves with the work and causes the carrier to pivot forward or backward.

The work is located on its outer buttress, with a tailstock center supporting the inner buttress. A hydraulic motor which is an integral part of the carrier drives the work. Approximately 0.015 to 0.020 inch of stock is removed by the stropping, and a surface finish of 40 to 60 micro-inches is obtained.

Lathes Face Both Sides of Discs Simultaneously

Compressor discs are steel forgings, thin in section and large in diameter. Contours on both sides, as well as bore and periphery, require machining. To eliminate "dishing" and to balance cutting pressures, both sides are cut simultaneously on a battery of twenty-nine P & W Adesigned Gisholt center-drive lathes. Another advantage is that the time for machining the sides is halved.

One of the lathes appears in Fig. 8. A large hollow bearing in the center of the machine accommodates the work. There are two conventional lathe carriages on opposite sides of the bearing, each with a cross-slide, square turret, and hydraulic tracer unit. A shaft in the base transmits the drive to the bearing.

The heading illustration is a close-up view of one side of the bearing, showing a 25-inch disc in position. Preparatory operations on a vertical turret lathe consist of taking a qualifying cut, turning the outside diameter, and grooving and facing a clamping surface. In the center-drive lathe, one of the first steps is to take a light facing cut on each side, to secure a true surface for a roller (seen prominently in the illustration) which serves as a steadyrest.

After the disc is bored out from one turret, contour-facing cuts are taken in unison from both

Fig. 10. Throw-away inserts are standard for most single-point machining operations. A variety of inserts and tool-holders used appear here.



Fig. 9. Two templates and two cutters permit the return stroke as well as the forward stroke of the carriage to be used for machining.



turrets. To maintain a constant cutting speed, carrier rotation originates from a variable-speed drive. A cam on one of the cross-slides speeds up the motor generator as the facing cutters approach center.

Tracer Lathe Feeds in Two Directions

Because of an intricate internal configuration, rear compressor drive turbine shafts are bored on a New Britain G F copying lathe. Parts of the contour are back faces and back chamfers, inaccessible to the usual tooling practice for the machine. To do the job, the machine (Fig. 9) is equipped with two templates and a two-cutter boring-bar.

In a preliminary operation, a clearance hole is bored for the bar. Then, as the bar advances toward the headstock, one of the cutters, guided by its respective template, machines the bore diameters and all walls and chamfers it can reach normally. When the bar has reached the end of its forward travel, its axis is shifted slightly, bringing the second cutter (diametrically opposite the first cutter) into operating position. At the same time, the second template is interchanged with the first one, and the back faces and back chamfers of the shaft are machined as the bar feeds away from the headstock. For the next piece, the bar axis is again shifted and the first template is used.

Cutters used in this tracer operation are throwaway carbide inserts. This type of cutter has found wide acceptance at P&WA during the last two years. Today, virtually all single-point carbides are throw-aways. Certain advantages are claimed for their use: Inserts have a low initial cost; it takes little more than a minute to index an insert when an edge has worn; the new edge generally will repeat within plus or minus 0.003 inch of the worn one, requiring a minimum of correction to a template or dial clip; grinding is dispensed with; and an inventory of the inserts requires very little physical space.

Some of the inserts and tool-holders used at the plant are illustrated in Fig. 10. The toolholders were developed jointly with the carbide manufacturers and are designed to support the

Fig. 11. "Casket" formed by hood dampens area noise while honing. Unable to see work, operator recognizes end of cycle by sound of honing tool.



Fig. 12. More than a thing of beauty, the mirrorlike surface produced will prevent service failure from cracks set up by tool marks.



Fig. 13. Warming the ring in a tank to the operating temperature of the spindle stabilizes its geometry.



inserts at proper side-rake and back-rake angles—positive for titanium, negative for steel. Inserts for the negative-rake holders have a double life, having cutting edges available on the bottom as well as the top. Tool-holders for deep grooving, like the one at the left in the foreground, have a coolant connection directly in the shank which forces the coolant out under the insert.

Honing Machine Hood Dampens Vibrations

To avoid service failure of the jet engine from fatigue cracking, rigid "specs" have been set up for the surface finish of many critical parts. One of these is the front compressor drive turbine shaft, made from a molybdenum-steel hollow forging. Final operation consists of honing the large bore on a Micromatic machine, Fig. 11.

The work surface is 3 1/2 inches in diameter and approximately 4 feet long. It is held in a universal fixture (there being two other sizes of these shafts also in production) and the hone both reciprocates and rotates. About 0.010 inch of stock is removed by honing.

During the operation, a hood is lowered over the bed to isolate the high-frequency honing vibrations from the grinding machines in the immediate shop area. The lining of the hood is composed of sponge rubber. Coolant flows over the umbrella type honing tool and through a filtering and refrigerating unit.

Tool marks, always a possible source of metal fracture, are removed from the faces of compressor hubs on a polishing jack, Fig. 12. The

operator uses a small air motor to drive a rag wheel coated with 240 grit abrasive. The wheel is directed against the work as the hub revolves on the stand.

Work Warmed in Cutting Oil

Stainless-steel disc spacer rings require a circle of sixteen holes, accurate in location within 0.0005 inch. These rings are gun-drilled on an Ex-Cell-O boring machine, two holes at a time, with eight indexes of the work. The operation is illustrated in Fig. 13.

Part of one of the rings is visible in the tank attached to the front of the machine. This tank contains cutting oil which circulates continuously, being integral with the coolant system of the machine tool. While one ring is in work, the next ring is put in the tank, where it is warmed by the cutting oil. In this way, no change occurs in the geometry of the ring during the gundrilling, and the close tolerance on hole location is preserved.

Complementing the manufacturing activities is a machine repair program involving the services of a score of men. Each is a specialist on some particular kind of machine tool. The majority have received formal training in their jobs, both at North Haven and at the plants of the machine tool builders. Minor repairs and maintenance take place during any of the plant's three shifts. For major repairs or required modifications, a machine will be removed from the line and brought to a designated area.



UB-ZERO quenching and the use of subzero coolants in machining operations on aluminum, alloy-steel, titanium, and phenolic parts have resulted in remarkable savings in the manufacturing departments of the El Segundo Division, Douglas Aircraft Co., and at the same time, have considerably improved work finishes. There are three variations of sub-zero treatment followed in this plant. First, there is a dip process that is applied after the heattreatment of certain parts to prepare flat blanks and extrusions for forming operations. Second, sub-zero coolant is directed to the point of contact between cutters and the work in machining operations on machine tools, and the work is submerged in the bath. Third, a sub-zero and boiling water treatment is used to stabilize forgings, large bar stock, and steel or aluminum plate for the purpose of preventing distortion during machining operations.

Dipping or quenching operations on workpieces are performed in two sequences. First, the part is immersed in a tank filled with refrigerated water which brings the blanks or parts from heat-treating temperatures down to plus 40 degrees. F. The parts remain in this tank for thirty seconds. This first step in operation facilitates maintenance of the low temperature in the subzero coolant which is contained in an adjoining tank into which the parts are plunged immediately after their removal from the cold water bath. The sub-zero tank is filled with ABCO—156 Solvolene, a product of the American Better Chemicals Co., Inglewood, Calif. This bath is kept at a constant temperature of minus 40 degrees F.

The mechanical equipment that maintains this constant temperature in the refrigerated water and sub-zero tanks is shown in Fig. 1. It consists essentially of a recirculating unit for the water tank and a plate type refrigerating system for the sub-zero tank.

Sub-zero quenching, by maintaining the ductility of work-pieces in the "as quenched" state, has eliminated work breakage in many forming operations. A wide variety of hard-to-form parts that previously had a high scrap factor are now formed true to size, and some parts that previously could not be formed at all are now produced with ease. On some press products, 75

Improved quality of parts made from various metals for fabrication into airframes is the important advantage gained by employing the techniques described in this article. Three variations of sub-zero treatment are followed—a dip process after heat-treatment, the supplying of coolant during machining and a sub-zero and boiling water treatment.

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MACHINING AND QUENCHING

per cent of the hand forming previously required after rubber forming has been eliminated.

The success of sub-zero quenching in forming operations led to the adoption of sub-zero coolant as a thermo-shock treatment in machining setups. Under this treatment, forgings become stabilized and can be machined without warpage or distortion to blueprint tolerances. Tool life has been substantially increased.

Parts of SAE 4130 chrome-molybdenum steel held at sub-zero temperature are sawed in one-half the former cutting time. There is no evidence of hardening on the work edges, and a considerably better finish is obtained. The soft burr produced can be removed easily by hand scraping.

Chrome-molybdenum steel heat-treated to a tensile strength of from 260,000 to 280,000 psi has been machined on an engine lathe with subzero coolant supplied to the cutter edges at spindle speeds and rates of feed that are impossible under normal conditions. Although the tool life in conventional operations is short and costly, repeated cuts have been taken under the new process with no measurable wear on the

tool, even though finishes from 19 to 20 microinches have been obtained.

Numerous production runs have been made on a large milling machine on such materials as chrome-molybdenum steel, stainless steel, and titanium with unusually good results. In all cases, the parts machined were of the problem type on which cutters ordinarily have a short life and good work finish is difficult to obtain.

The heading illustration shows a milling operation in which the sub-zero coolant (ABCO-156 Solvolene) is being applied. Fig. 2 shows a general view of the same machine with the "cold equipment" in the foreground. The reservoir for the sub-zero coolant is at the right. A centrifugal pump forces the fluid through a 2-inch tube which delivers it to the gang cutters and the work, as shown. The coolant brings the cutters and the work down to a temperature of between minus 40 and minus 50 degrees F. The coolant collects on an inclined pan on the table of the machine. This pan is of aluminum and is insulated against heat from the machine table. The coolant drains from the pan by gravity back to the reservoir.

Fig. 1. Equipment which maintains a temperature of 40 degrees F. in a refrigerated water tank and supplies sub-zero coolant to a dip tank.

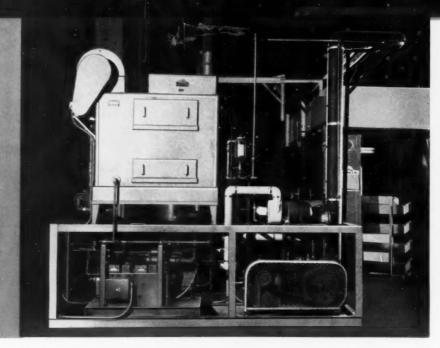
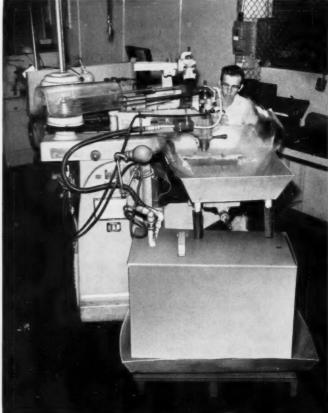


Fig. 2. Equipment at the rear of a horizontal milling machine supplies sub-zero coolant through a 2-inch tube to the cutters and work.

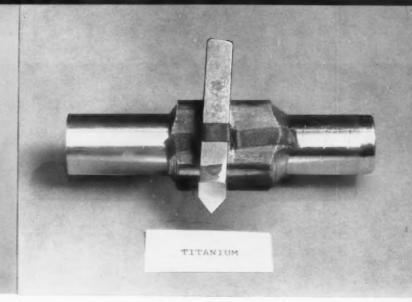
Fig. 3. Arrangement of sub-zero cooling equipment on a pantograph type machine used for a variety of duplicating operations.





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Fig. 4. The left-hand end of this titanium bar was machined during the application of sub-zero coolant; the other end, under normal machining practice.



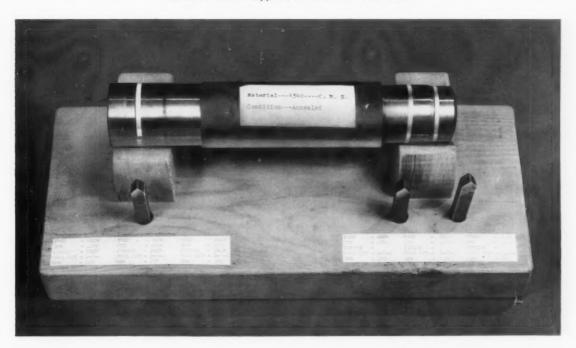
The technique in operations of this type is to immerse the work part in the reservoir from ten to fifteen minutes, depending upon the cross-section of the part, before placing it on the machine fixture. This chills the part prior to machining.

Another sub-zero machining operation is illustrated in Fig. 3, which shows a Gorton pantograph type machine that is used for a variety of duplicating operations. In these operations, the use of sub-zero coolant has been successful far in excess of expectations. Cutter life at the high

speeds used has been almost unbelievable. On chrome-molybdenum steel, stainless steel, and titanium there has been no appreciable cutter wear, and the work finish is of high quality.

The type of finish obtained on a titanium bar when the sub-zero process is employed can be compared with the finish formerly obtained on the same part by referring to Fig. 4. At the left is seen the surface obtained under conditions of sub-zero cooling, while at the right is a finish normally obtained under conventional machining practice. The cutter used in this work is seen

Fig. 5. Chrome-molybdenum steel bar of which the left-hand end was machined under conventional practice and the right-hand end with sub-zero coolant supplied to the cutters and work.



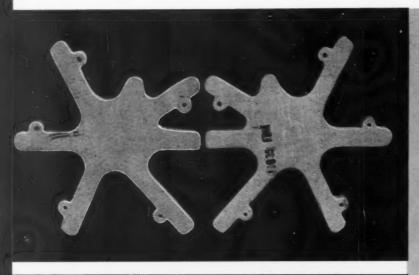


Fig. 6. Two phenolic parts 1/2 inch thick, the left-hand example having been routed under conventional practice and the right-hand example with sub-zero coolant supplied to the work and routing tool.

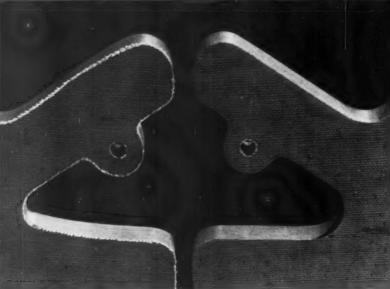


Fig. 7. Close-up view of the parts in Fig. 6, showing the ragged edges obtained with conventional routing and the clean edges that are achieved with sub-zero machining.



Fig. 8. To stabilize parts, they are immersed first in a cold bath and then in a hot bath. The equipment that is used in this combined sub-zero quenching and boiling water quenching is here shown.

attached to the work-piece. In Fig. 5 is an example of a chrome-molybdenum shaft on which the left-hand end was turned under conditions of normal practice, and the right-hand end with the cutters and work supplied with sub-zero coolant. It should be noted that the highest finish on the right-hand end was obtained with a work speed of 278 rpm. The depth of cut in all cases was 0.060 inch.

The favorable results obtained by providing sub-zero coolant in routing operations on phenolic sheets is strikingly apparent in Figs. 6 and 7. At the left in Fig. 7 may be readily observed the ragged edges obtained on the phenolic sheets when normal routing practice is followed. At the right may be seen the clean edges obtained when sub-zero coolant is supplied to the routing cutter and the work. Obviously, the hand finishing of the fabric edge that was formerly necessary has been completely eliminated as a result of the

clean cut achieved. Moreover, the cutter life has been extended from two parts between grinds to seventy-five parts of this highly abrasive material. On work of this type, the cutter runs at 22,000 rpm. The phenolic sheet is 1/2 inch thick.

The successive sub-zero and boiling water quenches in the third treatment previously referred to are used primarily on forgings and bar stock that were formerly either impossible to form or could be machined only with excessive tooling costs. The parts are previously heattreated in some instances and in others they are in the T6 condition when they come to the quenching facility. By immersing the part first in the cold bath, which has a temperature of minus 100 degrees F., and then in a hot bath of 212 degrees F., the part can be stabilized to the point where machining distortion is minimized or eliminated. Fig. 8 shows the equipment used for this cycle of operations.

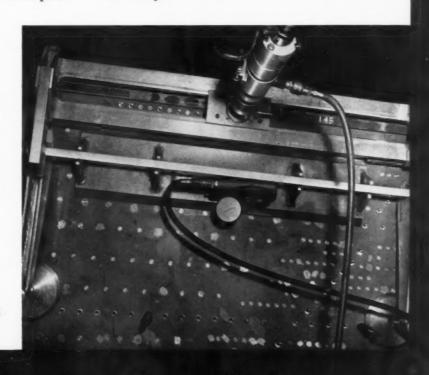
Suction Holds Rivet-Hole Jig to Aircraft Skin

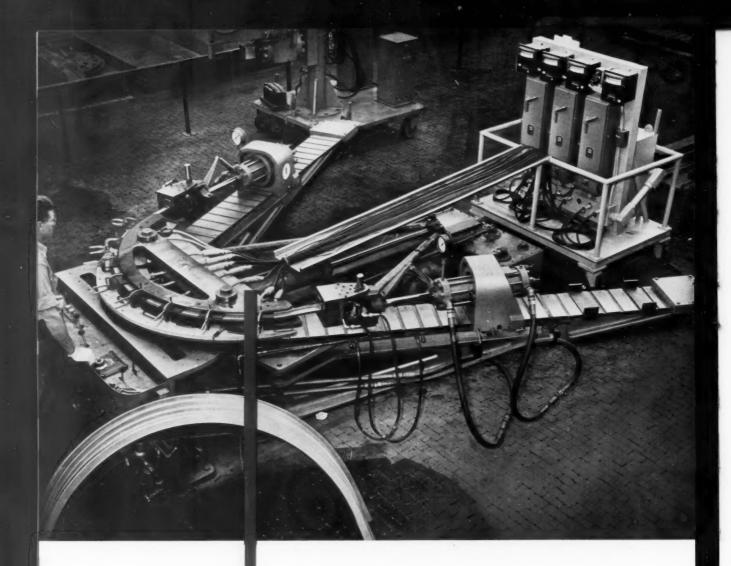
In building the Navy's P6M SeaMaster, the Martin Co., Baltimore, Md., has to drill and countersink thousands of rivet holes in the skins. To do the job accurately and economically, the company uses a Keller Airfeedrill in conjunction with a vacuum jig it developed.

There are three components of the jig—a vacuum plate, a slide assembly for holding the drill, and a clamp at each end of the slide assembly. A venturi, operating off shop air, draws the vacuum which holds the plate to the panel.

The jig rests on a pair of tracks attached to the skin. Notches along the lower track serve as locators for the drill. When the drill is in correct position, a lever enters the notch. After drilling and countersinking a hole, the lever is raised, and the drill moved along until the lever enters the next notch. When the last hole within the range of the slide is completed, the vacuum is released, and the jig is moved to a new location. Pressure on the assembly is increased by tightening the two clamps.

Front view of skin in which rivet holes are being drilled and countersunk. Jig is held against skin by vacuum pressure as drill progressively produces the holes from one end of the slide to the other.





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HEATTHE KEY TO
FORMING
TITANIUM

Unlike mild steel and aluminum, which can be formed at room temperature, titanium requires controlled application of heat to prevent distortion and in-process failure. How, then, is this heat to be applied at the right time and at the right place? In stretch-forming, universal heating blocks do the job—in drop-hammer work, the titanium blank serves as a heating element.

NTRICATE contours and small-radius bends can be formed in titanium details without fear of distortion or material fracture. Such operations are a routine part of a day's work at Martin. The key to the process is the controlled usage of heat, ranging in temperature from 300 to 1400 degrees F. depending on the final shape of the work and the forming method employed.

Two basic methods of heating are being pursued. One makes use of individual heating blocks to elevate the temperature of the work a few hundred degrees. In the second method, the work itself serves as a resistance heating element and is raised in temperature to a red heat. The titanium parts shown in Fig. 1 are typical of those produced by both hot stretch-wrap forming and resistance-heated drop-hammer forming.

Details are Stretched Against Heated Form-Blocks

Heated form-blocks are a requisite for the successful stretch-forming of titanium-alloy parts. However, between fifty and one hundred of these blocks must be designed, constructed, and stored for the production of only one aircraft, for example the P6M SeaMaster, a 600-mile-per-hour seaplane powered by four turbojet engines. Providing a built-in heating arrangement for each form-block would cause tooling costs to pyramid.

The answer was found in the development of individual electrical heating units that are universal in their application to virtually any form-block. Four of these flat heating units are shown on a work-bench, together with one quick-disconnect cable, in Fig. 2. Because of their size and configuration, they can be arranged to conform with the shape of all form-blocks used.

In use, the heating units are attached to the under side of the form-block, as can be seen in Fig. 3. Heat is then transferred from the units into the block and from the block into the detail being formed. It is necessary, therefore, that the block be made of steel plate instead of Masonite. Large openings are cut in the steel block to keep

Fig. 1. Tail pipe details that have been fabricated of titanium alloys. These are typical of parts that are being produced by hot stretchwrap forming and by resistance-heated drop-hammer forming.

of heating are being purof individual heating blocks servicing a 17-ton Hufford stretch-wrap forming

machine. The form-block illustrated is being heated by nine of the individual heating units. Facilities for fifteen units are provided by the control panel.

its mass to a minimum. Several layers of asbestos

board are placed beneath the heating units to

with a control panel containing a 45-kva trans-

former having 440-volt primary windings. The control panel is mounted on casters so that it may

be transported easily from machine to machine

Quick-disconnect cables link each heating unit

retard the downward transfer of heat.

Constant temperature is maintained by the use of thermocouples. Wells are drilled and tapped in the form-blocks to accept three probe type thermocouples, while a fourth is inserted in one of the heating units. This last thermocouple can be seen in the heading illustration, extending from the second heating unit from the right-hand side of the form-block.

Four control units are mounted on the panel. Three of these are connected to the thermo-



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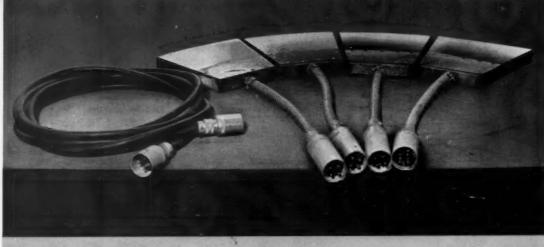


Fig. 2. Individual heating elements are used to raise the temperature of the form-block when stretch-forming titanium alloys. All the heaters are connected to a central control panel.

couples in the block to assure a uniform temperature throughout the member. The fourth controller is connected to the heating unit housing the thermocouple. This single thermocouple performs the function of an anticipator and prevents the other units from overheating.

Formability of titanium increases greatly at a comparatively small elevation in temperature. By this token, temperatures as low as 300 to 400 degrees F. have proved sufficient for the stretch-forming process.

The original part, being straight in most instances, makes initial contact with the form-block at one point only. This, then, means that only the immediate point of bend is brought to the proper heat. As the two hydraulically actuated arms pivot to the rear of the machine, the work material is wrapped around the form-block. Sufficient time must be allowed during the wrapping operation for adequate heat transfer to take place between the block and the work at each instant of contact. Although this transfer occurs at what is considered a fast rate, the process is admittedly slowed down to approximately half the speed that would normally be used. It is important that a uniform heat be maintained along the area of bend. In view of the high tensive forces being imposed on the work, any hot spots might very likely result in localized over-stretching and possibly work failure on the machine.

Little, if any, springback is encountered even though the parts are not over-formed. Final shape is maintained by retaining the work, after completion of the cycle, at heat and under tension for a sufficient period of time to permit the

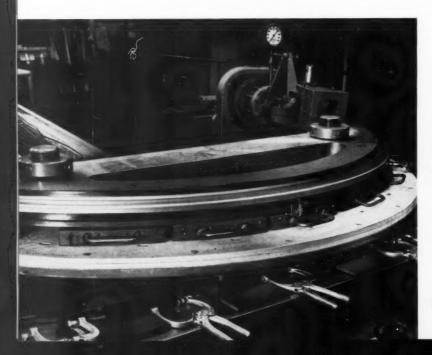


Fig. 3. A battery of heating elements has been placed beneath a steel form-block on this 17-ton stretch-wrap forming machine. Four thermocouples are used to control the temperature of the form-block.

Fig. 4. Aluminum tabs are welded to the titanium blank to serve as electrode gripping areas. By using aluminum for this purpose, it is possible to minimize the amount of titanium that will end up as scrap when the finished part is trimmed.



work to take a permanent set. All formed titanium-alloy details are required to undergo a stress-relieving operation.

Titanium Serves as Heating Element in Drop-Hammer Forming

Heat is a factor to be considered when drophammer forming titanium as well as when stretch-forming. There is, however, a difference in the intensity of the heat and in the method involved. Since heat transfer directly from the dies is not practical, another method of bringing the blank to the necessary temperature is re-

Titanium, a material of high electrical resistance, is ideally suited for this type of heating. Elevated temperatures can be obtained with

proved to be the answer.

quired. Resistance heating of the work-piece has

relatively low voltages. The developed blank is clamped to the electrode terminals and heated while suspended in the correct forming position. This method permits the realization of maximum forming temperature with a minimum loss of heat. The temperature achieved is dependent on the area and thickness of the detailed blank as well as the magnitude of the electrical power.

To achieve uniform temperatures, the developed blank must be of uniform cross-section throughout its entire area. Any deviation will result in a higher temperature in the area having the smallest cross-section. Operations that alter the cross-sectional area—such as cutouts and lightening holes—must be completed after forming. Another factor that influences the temperature of the developed blank is its shape. Blanks that are of curved configuration develop higher temperatures along the inner curved edge.

Use of resistance heating makes it necessary for the developed blank to extend in length beyond the confines of the die to enable the material to remain clamped during the forming cycle. It is apparent that an excessive amount of scrap metal is involved. To reduce the amount of expensive titanium required to a minimum,

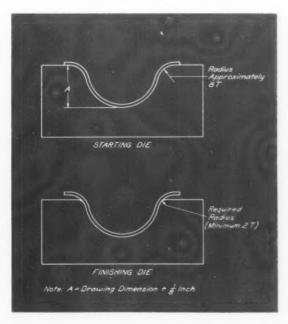


Fig. 5. Corner radii of 2T are to be formed in the blank shown in Fig. 4. To accomplish this, two dies are used—the first die bringing the radii to 8T, the second one reducing them to 2T.

Fig. 6. Duct member is shown following the initial forming strike. The aluminum tabs are firmly gripped by electrode clamps at either end of the die member.



aluminum tabs are fusion welded (using an aluminum filler rod) to each end of the blank to serve as electrode attachment areas. A secondary benefit is that the area of resistance is reduced due to the excellent conductivity of the aluminum tabs, thereby reducing the power required to achieve the desired temperature elevation. The tabs can be made of the following alloys: 1100-0, 5052-0, 6061-0; and they can vary in gage thickness from 0.032 to 0.064 inch.

In Fig. 4 can be seen a blank of A-110 AT Rem-Cru titanium that has already had two aluminum tabs welded in place. The part is to be formed into one-half of a duct for use in a high-temperature, high-pressure de-icing system. An interesting feature of this particular operation is that the flange corners must be formed to a radius of two times the material thickness. Normally, the minimum radius would be four times the material thickness.

Two dies are required to form a corner of as small a radius as this—a first operation, or starter, die and a second operation, or finishing, die. The application of these is shown diagrammatically in Fig. 5. For short runs, the drop-hammer tools are of the conventional type, that is, a Kirksite die and a stainless-steel jacketed lead punch. The die can be seen below the welded blank (mounted on a Chambersburg Cecostamp) in Fig. 4.

Shoulders and lead traps must be either omitted or modified on all dies to be used in conjunction with the resistance heating technique. Since the developed blank projects beyond the limit of the die, any shoulders that might be present will create a shearing action on the work. The aluminum tabs will be severed, thus rendering the detail useless for further heating.

When employing the resistance heating method, the die surface must be electrically insulated from the developed blank during the heating cycle to prevent a short circuit from occurring when the blank being heated contacts the drophammer die. Should contact be made between the two members, local overheating and pitting of the work material will result. Electric insulation is obtained by first thoroughly cleaning the surfaces to be insulated, which are the upper surfaces of the die member, then brushing on a thin film of liquid Sauereisen cement.

When the film dries, a forming lubricant is applied to the die. This consists of a thin coating of Molylube—a molybdenum disulphide powder carried in an oil vehicle.

Low voltage and high amperage are supplied by a 50-kva mobile power pack. A maximum of 40 volts is available. In the illustrated forming, a current flow of 1200 amperes at 10 volts is used.

Prior to the first strike, the blank assembly is positioned over the die member. The aluminum tabs are then secured between the jaws of the electrode clamps located at either end of the die. Current is turned on for a few seconds, just long enough to bring the titanium portion of the weldment to a temperature of 1100 degrees F. When this temperature is reached, electricity is shut off, and the first strike is made. Results of the first forming operation can be seen in Fig. 6.

For the final operation, this punch and die is replaced by the finishing punch and die. Once again the work is positioned over the die member, and the aluminum tabs are secured to the electrodes. To set the finished detail and to increase formability, the work is brought to a temperature of 1400 degrees F. for the final

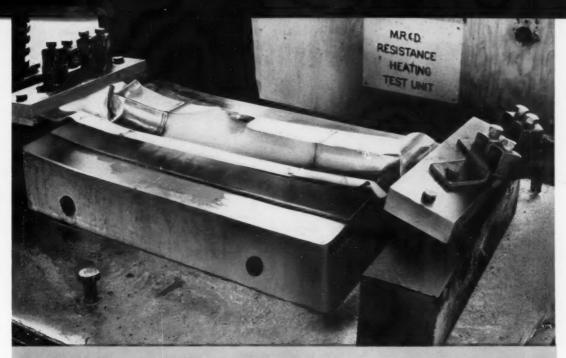


Fig. 7. Current is turned on just prior to the forming strike in the second of two dies. The titanium section is at red heat, while the aluminum tabs are cool to the touch.

strike. Although the titanium is at a red heat, as shown in Fig. 7, the aluminum tabs are cool enough to be touched by hand. To reach a temperature of 1400 degrees F., current flow is maintained for a maximum of twenty seconds, then shut off as the punch descends.

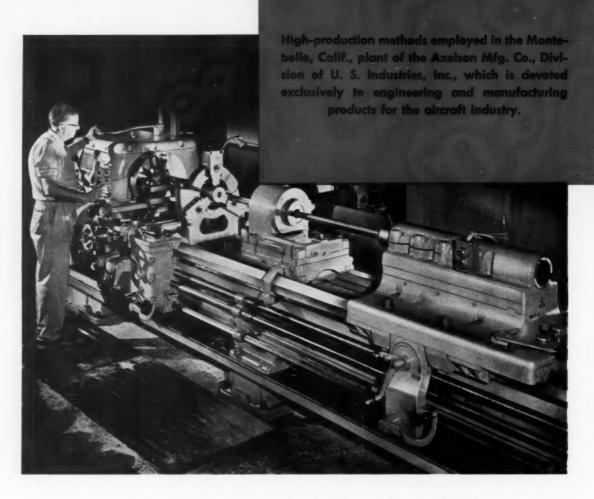
Following this final forming step, the titanium duct section is rough-trimmed on a high-speed Tannewitz friction type band saw. After trimming, the drop-hammer details are placed in a 20 per cent nitric acid bath to insure the removal of any lead and zinc particles that may have been picked up from the die.

The part is then placed in a molten salt bath at a temperature of 800 degrees F. to loosen the scale that is present. Complete removal of the scale is accomplished by quick-dipping the parts in a bath consisting of 30 per cent nitric and 2 per cent hydrofluoric acid, by volume, with the remainder being water. After the two mating duct halves have been joined by welding, they are stress-relieved.

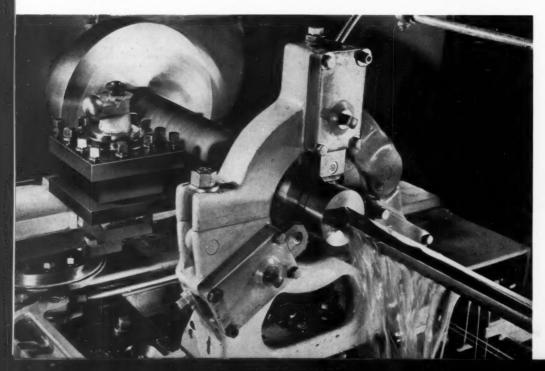
It can be said that in applications such as described, resistance heating is ideal for achieving the necessary high temperatures for forming titanium parts. It permits minimizing the total time that the material must be held at these temperatures. This is essential, as titanium becomes embritled when subjected to elevated temperatures for prolonged periods of time. Controlled temperatures that are higher than those feasibly attained by furnace heating can thus be realized. Another important factor is that the blank is heated while in the correct forming position.

P6M Martin SeaMaster



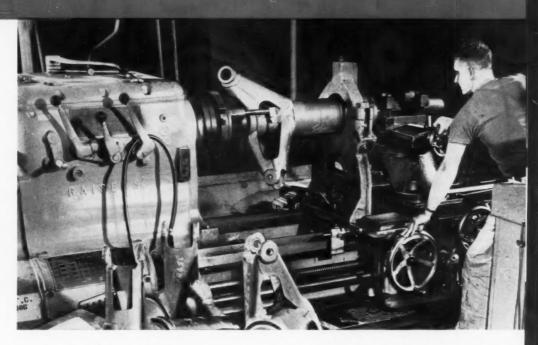


Gun-drilling an aircraft landing-gear part of Hy-Tuff steel 36 inches long on an Axelson lathe. Bore size is being held to 1.730 inches. Present cutting time of 1.3 hours is a substantial improvement over the 4 to 6 hours formerly required by conventional drilling methods.



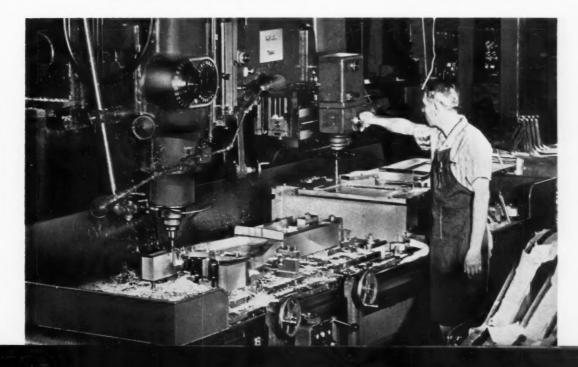
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AXELSON MACHINES WIDE VARIETY OF AIRCRAFT COMPONENTS



(Above) A number of aircraft components having integral extensions must be turned and bored on lathes that have exceptionally high headstocks and elevated cross-slides.

(Below) Parts such as the aluminum wing "carry through" here being produced on a Hydro-Tel milling machine must often be "carved" out of big slabs of metal.



MACHINING

(Above) Gang-milling operation on a Kearney & Trecker machine in which four faces of two bosses on an aluminum landing-gear part are being finished to close tolerance limits.

(Above) Drilling a large hole in a lathe operation performed on a landing-gear component made of SAE 4140 steel. The part runs at 22 rpm, and the feed is 0.006 inch.

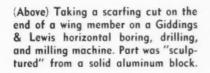
(Left) Contouring two aluminum wingassembly rib chords on a huge Cincinnati Hydro-Tel milling machine. Intricate movements of the cutters are controlled by a stylus which follows an overhead template.

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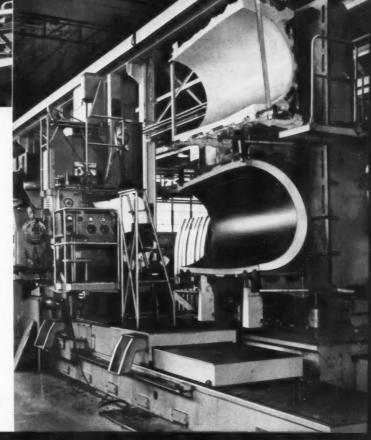


(Above) Trepanning operation on landing-gear part in which a bar

(Above) Trepanning operation on landing-gear part in which a bar of Hy-Tuff steel is accurately machined to a diameter of 2 11/16 inches for a length of 33 inches.



(Right) Iron casting for a wind tunnel unit after being contoured internally on a Keller machine. Above the work is the plaster form used to automatically control the cutter position during the entire operation.



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By C. L. HIBERT, Senior Design Engineer Convair, a Division of General Dynamics Corporation San Diego, Calif.

REQUIREMENTS for reduced weight and additional space in current and prototype aircraft have led to the production of a large number of intricately shaped parts. With the proper design, many of these components can be made with a simple and economical process—chemical milling.

Preliminary development and research at Convair indicate that this production method has broad scope. But the manner in which workpieces may be modified to make their production by chemical milling attractive from the economic standpoint is not always evident to the designer.

Basically, chemical milling is an etching process. It is presently used to execute complex engineering designs with a simple masking technique. Templates used in a wing-tip masking operation are seen in the heading illustration. Relatively unskilled labor and unpretentious production facilities such as tanks and solutions are employed (Fig. 1). Aluminum alloy, magnesium alloy, titanium alloy, and stainless steel have all been milled chemically. Although versatile, the process is adaptable in a greater degree to sheet

metal or plates than material in other shapes. Typical applications are seen in Figs. 3 and 4.

With the advent of chemical milling, a new means of dimensional control is exploited—time. Fortunately, instrumentation for this basic quantity is readily available, making tolerances easy to achieve. Moreover, many operations may be performed and regulated simultaneously.

The etching is uniform throughout the unmasked portion of the work-piece, and the depth of cut is dependent on the time of exposure to the solution. Another basic characteristic of chemical milling is that a radius approximately equal to the depth of cut is formed along the edge of the masking material (Fig. 2). In addition, the hardness of a metal does not affect the rate of its removal. This fact is interesting when considering the use of alloy steel in aircraft.

Design Considerations

Chemical milling can be performed after forming operations. Complex shapes, broad or narrow cuts, and comparatively sharp corners are pos-

DESIGNING WORK-PIECES FOR CHEMICAL MILLING



sible in one operation. However, a limiting relationship exists between the depth and the width of a cut (Fig. 2), and cuts greater than 0.25 inch may result in extreme roughness at the edges. In the case of heavy plate, which by nature of the rolling process is of coarser grain, a greater degree of roughness is produced. The process can be applied to complex contoured or formed parts, and metal may be removed from both surfaces of a sheet simultaneously. This latter operation prevents warpage in a sheet metal part.

Chemical milling permits the design of integrally stiffened sections. These lighter weight and simplified members eliminate riveting, seams, and the spot-welding of doublers. Sandwich construction appears more feasible than it has in the past, since heavy lands can be left on a panel wherever any attachment is to be made.

Sheet thickness can be held to tolerances of plus or minus 0.002 inch with chemical milling. Tolerances obtained with various depths of etch are given in the accompanying table.

Depth of Etch, Inch							Tolerance, Plus or Minus, Inch										
Up to 0.030																	0.002
0.031 to 0.060																	0.0025
0.061 to 0.090																	0.003
0.091 and over								+				+	٠	+			0.004

In step-etching (Fig. 5), the tolerance must be held closely on the thinnest section. If the operator is to have the full allowance on the thin section, the heavier sections must have added tolerance. For instance, if at the conclusion of the first etch the operator makes the second cut two-thousandths shallow and then brings the thin section down to the upper allowable dimension, the second cut will be two-thousandths out of tolerance. The solution of this problem is to specify close tolerances on the thin section only.

Chemical milling permits tapering of sheets, extrusions, hat sections, and other parts suitable as stiffeners to distribute design stresses proportionally. Tapered sections are more easily produced if they exceed 5 inches in length. However, tapers with lengths as short as 3 inches have been accomplished. Bands or stiffeners can be produced integrally with the skin and may be curved or contoured so as to direct the stress transfer as desired. In addition, various depths of cut, within process limits, can be taken on large areas of one sheet by a method of progressive unmasking.

Physical and mechanical properties of the stock are not impaired by chemical milling. However, the fatigue properties may be affected by roughness and notches along the edge of cut radius. Chemical attack is uniform from any



Fig. 1. Chemical milling facilities are simple, consisting primarily of tanks, hoists, pumps, and etching solutions.

point of the exposed or unmasked area. This phenomenon results in a radius at the edge equal to the depth of the material removed, as seen in Fig. 5. Therefore, the minimum width of cut must be more than twice the depth (Fig. 2).

When masking materials are to be used, the depth of cut is limited to 0.25 inch. Experimental cuts of up to 0.50 inch have been produced. With the deeper cuts, gas is trapped beneath the masking material. This gas cannot be displaced by agitation of the solution, and uneven etching in these areas results. The problem is not insur-

mountable, but edge roughness on heavy plates and forgings limits the depth of etch.

Chemical-milled parts require no further finishing, such as sanding and polishing, but masked edges are sharp and may require rounding. Surface roughness resulting from the etching process is in the order of 125 to 150 micro-inches. Edge grain on deep cuts will approximate 200 to 300 micro-inches. Tapering is accomplished by gradual immersion or removal of the work-piece from the solution. Surfaces as thin as 0.002 inch have been achieved with excellent uniformity.

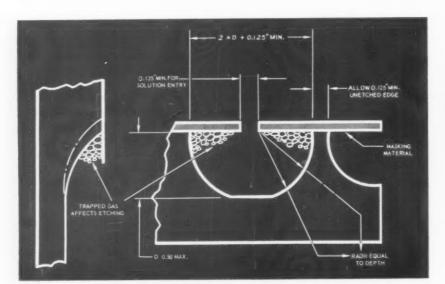


Fig. 2. A radius equal to the depth of etch forms along the edges of the cut. Gas trapped under the masking causes a roughening to occur at the radius.

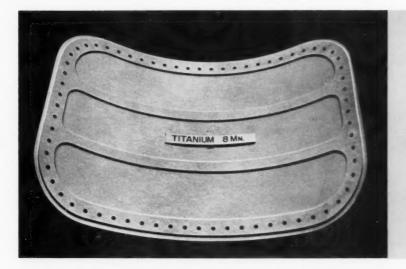


Fig. 3. Titanium alloy can be milled chemically. Components with integral reinforcement and locations requiring additional thickness of material for fasteners are readily produced.

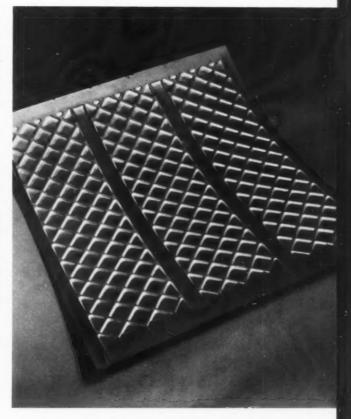
Specific Applications

Difficulty has been experienced in designing with large-diameter thin-wall tubing of aluminum alloys, primarily because it is not commercially available. In addition, there is a limitation on the bending of such tubing that is determined by the wall thickness. With chemical milling, it is possible to produce bent sections of thin-walled ducting by reducing the wall thickness of standard tubing to the desired measurement after forming has been accomplished. The tubing may be masked on the periphery, or the ends may be plugged. However, etching of both surfaces simultaneously is satisfactory from a production standpoint. There are practical limits to chemical milling that involve the proportion between the size of the inside diameter and the length of the tube.

When designing forgings and extrusions, the thickness of certain webs and sections is determined by the nature of these processes. By chemical milling, it is possible to obtain work-pieces with a prescribed wall or web thickness from forgings and extrusions. The amount of material to be removed on thin sections to meet the design requirements is calculated and added to the remaining heavier sections. Then, by chemical milling the part all over, it is possible to meet the finished dimensions. This method does not require any masking, but it does require a rotating fixture to obtain uniform etching in any deep pockets.

Fig. 4. This wing-tip section is chemical-milled. Masking allows removal of metal in areas of any shape to depths within the limits of the process. Convair is investigating the possibility of machining forgings and other parts to an over-all dimension somewhat larger than that specified and then chemical milling all over to the blueprint dimensions. This may eliminate some of the warpage problems.

With certain weldments, it is desirable to have an upset section in the welded area to compensate for reduced strength values in this zone. By



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the use of chemical milling, it is possible to start with a heavier gage sheet, mask the area to remain as the upset, and chemical mill the remaining area to the proper gage thickness.

A factor that often has an influence on material thickness selection is its availability in standard sizes. With chemical milling, it is possible to reduce a standard gage thickness to a lesser non-standard gage, or taper the part in one or two directions for the purpose of weight reduction.

In many cases a heavy stiffener section is required on the compression side of channels, and often an additional strip of material is spotwelded or riveted in place. It is possible to make the section integral by starting with a heavier uniform section and reducing the tension side by chemical milling. Local plastic instability in compression forming depends on the method of loading, lateral restraint, and cross-sectional area. The first two items are a tooling problem, but increasing section thickness will aid in compression forming. By utilizing chemical milling, it is possible to start with a heavier gage material.

When hose clamps are used, thin-wall tubing requires additional thickness of material to reinforce the compression area. This is usually accomplished by spot-welding a strip of sheet metal on the inside surface at each end of the

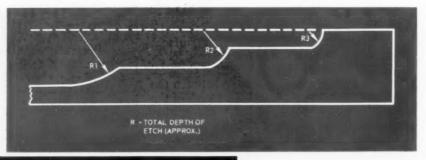
tube. The strip restricts the flow and increases friction. In a similar construction shown in Fig. 6, the reinforcement is the unetched portion of heavier wall tubing. The outside diameter for the remainder of the length has been reduced to the required dimension by chemical milling. Such heavier wall tubes are easier to bend with less tendency to form compression wrinkles. In addition, the reinforcement is on the outside and integral with the tube.

It is possible to form integral reinforcements for better stress distribution and provide the additional thickness that is required for countersunk head rivets or other fasteners. Such an application is shown in Fig. 7.

Clad aluminum alloys are required for spot-weld joints in order to protect contacting surfaces from crevice corrosion. From a strength-weight standpoint cladding is undesirable. However, cladding can be readily removed by chemical milling the areas of the sheet not joined to another assembly.

When producing plated screw threads in aluminum alloy, the threads can be machined to the final, standard dimensions and then under-cut an amount equal to that of the plating with a chemical milling process. As etching is the reverse of plating, the metal is removed in the same

Fig. 5. (Right) In stepetching, the edge radius varies with the depth of cut. The work-piece is unmasked for each step in sequence.



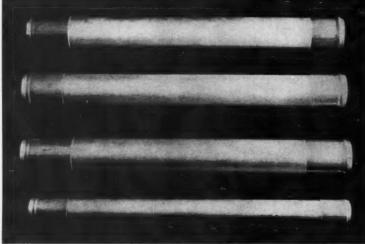


Fig. 6. (Left) Thin-wall tubes with external end reinforcement to permit the use of hose clamps are chemicalmilled from heavier tubing.

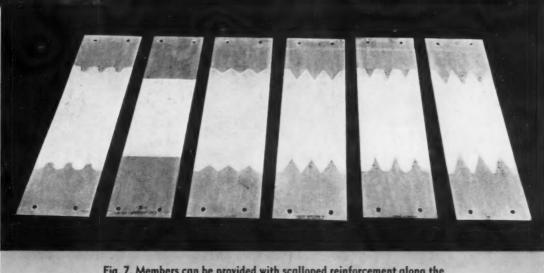


Fig. 7. Members can be provided with scalloped reinforcement along the edges in order to obtain a better stress distribution.

proportions as plating restores it to the threaded work-piece.

The operation is performed by placing the aluminum parts to be under-cut in a tumbling barrel of dilute etchant at room temperature. Epoxy chips which closely approximate the specific gravity of aluminum are then added as a separating agent. The tumbling barrel rotates at

about 8 rpm. By this method the screw threads of aluminum-alloy fittings may be etched to the correct preplating dimensions. Since the amount of material removed can be gaged on one dimension, such as diameter, the need for preplate thread gages is eliminated. Necessarily, the solutions and other details of the process must be controlled.

Materials Used in Latest Type Fighter Aircraft

An indication of the latest trends in the application of materials in airframe construction is afforded by the F8U-1 Crusader Navy fighter, which is being built by Chance Vought Aircraft, Inc. For example, although comparatively little was known of the characteristics of titanium alloy in the initial stages of design, now—as a result of cooperation between the designers, the technical staff, and the manufacturing research department—a total of 650 pounds of titanium and titanium alloy is incorporated in each aircraft. This material is used mainly to withstand the heat generated in the aft section of the J-57 jet-propulsion unit but is also used for light, high-strength fastenings.

In addition, ferrous and non-ferrous castings have been utilized with good effect. Thus, 275 sand castings of magnesium alone are incorporated in the design with individual weights from a few ounces to 13 pounds. Wall thicknesses of 0.1 inch are not uncommon for such castings, which are frequently supplied to fairly close tolerances so that little machining is required.

Some thirty-five different precision steel castings are employed in the airframe, the majority of which are heat-treated to 180,000 psi minimum tensile strength, and twenty-five more steel castings are used in special support equipment. In general, no machining is required on these castings other than hole drilling. Also, a considerable quantity of high-strength (260,000 to 280,000 psi), heat-treated steel is being used for some fifty different parts.

Rocket-launching tubes are made from aluminum-alloy extrusions, and because this process necessitates a greater wall thickness than is necessary for strength in service, the external surfaces are chemically etched to reduce weight.

INTEGRALLY STIFFENED WING PANELS FORMED BY SHOT-PEENING



By KENNETH SPARLING

Manufacturing Research Engineer Lockheed Aircraft Corporation Burbank, Calif.

THE concept of using large panels machined from aluminum slabs to replace complex assemblies in the aircraft industry has necessitated the development of new forming techniques. During the past year Lockheed has been shot-peen forming their large, integrally stiffened wing panels with much success.

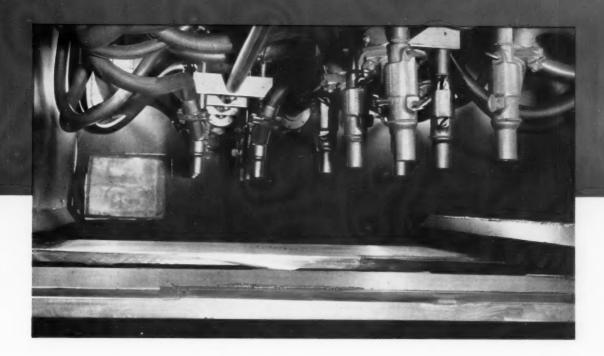
Forming is accomplished by the impact of 0.093-inch diameter cast-steel shot which is directed against the flat surface to produce a convex shape. The shot is propelled by high-velocity jets of air and makes small indentations on the surface of the work. A compressive layer about 0.020-inch deep is produced on the work surface (thick material), and a residual compressive stress of up to 50,000 psi is built up. This compressive layer tends to increase the length of the peened surface and, in doing so, causes the part to bend. As the part bends, the opposite, or concave, surface is also placed under compression until the two surfaces are in balance.

Shot-Peen Forming—a Big Step Forward

Formerly, using hot-bending methods, a single large Constellation skin required over twenty-five man-hours to contour. A 40-foot long panel now

Fig. 1. Large shot-peening installation is used to form integrally stiffened wing panels. A bucket type elevator at the right of the peening cabinet raises the spent shot 20 feet and dumps it into a separator unit.

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can be shot-peen formed in approximately three hours using the installation shown in Fig. 1. This includes machine loading, masking of non-peened areas, peen-forming to contour, unmasking, and unloading. If a panel should be overformed by peening, the error can be corrected by peening the opposite side of the panel.

Tooling costs are low. Only simple, flat templates for typical contours along the length of the panel are required. Since contours do not change rapidly, templates are made for stations about 6 feet apart.

How the Curvature is Controlled

Basic control over the curvature obtained on any particular panel section is had by altering two variables—peening intensity and degree of saturation. Intensity is controlled by adjusting the air pressure that drives the shot against the work. Adjusting the traverse table speed controls the degree to which the work is saturated with shot. These controls are at the operator's fingertips at the control station, as can be seen in Fig. 2. A window in the peening cabinet permits viewing of the work while in process.

Intensity and saturation can be altered during the peening cycle to compensate for different conditions of the work-piece. A constantly changing contour can be formed regardless of changes in section thickness (from 0.050 to 0.600 inch) or location of cutouts for doors and access holes.

Saturation is attained when the part is com-

pletely covered with dimples made by the shot: a complete obliteration of the original surface. In practice, the surface of the part need not be saturated for peen-forming. An increase in the degree of saturation is accompanied by an increase in the curvature of the part.

Intensity is measured with Type "A" test specimens (MIL-S-13165). Each specimen is 3 inches long, 3/4 inch wide, and 0.051 inch thick. They are of SAE 1070 cold-rolled strip steel that has been hardened from 44 to 50 Rockwell C. A specimen is bolted to a 3/4-inch thick steel block and exposed to the shot blast.

After being completely saturated, the specimen is removed from the holder and the arc height is measured on a No. 2 test gage. The gage measures the arc height of the test specimen at the center of four 3/16-inch diameter balls that form the corners of a 1.250- by 0.625-inch rectangle. If, for example, the measurement were 0.015 inch, it would be written as 0.015 A2. Increasing the intensity of the air flow will increase the curvature obtained.

Secondary Control of Curvature

In addition to the primary operating controls for saturation and intensity, secondary controls can be varied to influence part curvature. Distance between the discharge nozzles and the work surface can alter the resultant curvature. An increase in distance lessens the intensity and decreases the saturation for a given table speed

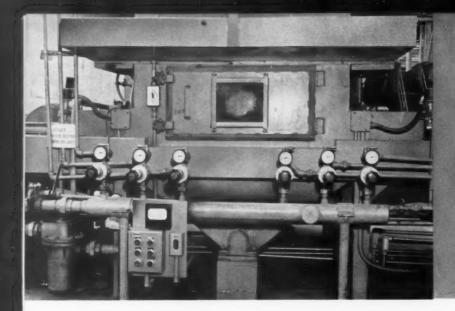


Fig. 2. One of two operating stations at the cabinet section of a large shot-peen forming installation. Pressure regulators and gages provide individual control for each of six nozzles.

and air pressure. The nozzles can be tilted to match the angle of the parts so that the shot blast will be normal to the surface. If normality is not maintained, maximum curvature will not result.

Smaller shot may be used, but the curvature obtained on aluminum alloys will not be as great as when using large shot at the same intensity. Nozzle size can also be changed to alter the saturation and area of coverage. The gates that control the flow of shot to the feed hoses can be opened or closed. By opening these gates, the flow of shot is increased—but only up to a certain point. After this point is reached, the quantity of

shot delivered is lessened and the flow becomes sporadic. All of these secondary controls are normally set at an optimum position and are not changed unless configuration of the parts varies radically from one to the other.

The peen-formed curve on any part depends entirely on operator judgement. No two parts react to the shot blast in exactly the same manner. Fortunately, normal tolerance on commercial wing panels requires that the gap between part and templates does not exceed 0.030 inch.

Other Effects of Shot-Peen Forming on Work-Piece Material

Severe iron contamination can cause surface corrosion of 7075-T6 aluminum alloy. To prevent this, and to remove any other foreign material that may have accumulated on the part, the panels are cleaned with a mild caustic solution immediately after peening. The panels are then given an Iridite corrosion-resistant treatment before painting and assembly.

Mechanical properties of 7075-T6 aluminum alloy are not radically altered by shot-peening. Although the ultimate tensile strength is not changed, the yield point is reduced somewhat depending on the material thickness. Tests have shown reductions of up to 7 per cent on 0.040-inch thick material, and up to 1 per cent on 0.500-inch thick material. Fatigue strength is improved slightly. Corrosion resistance is greatly improved due to the residual compressive stress in the surface of the peen-formed part.

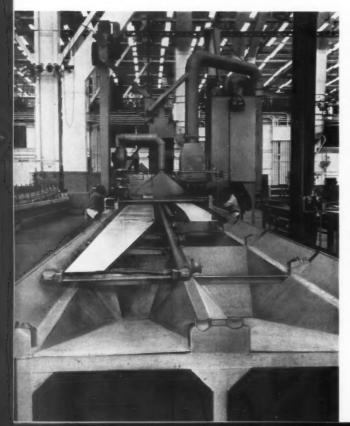


Fig. 3. The machine bed supports two 45-foot long tables that can be operated either individually or in unison. One operator at each of two control stations supervises the forming of each integrally stiffened wing panel.

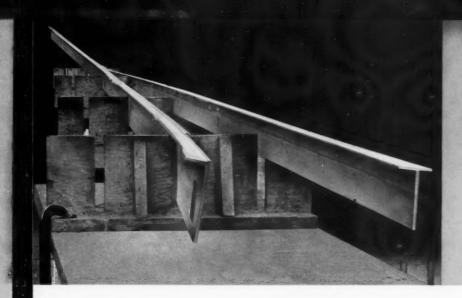


Fig. 4. Shot-peen forming installation can be used for emergency salvage operations. At the left is a long wing beam cap distorted during machining. At the right is a similar part after straightening by shot-peening.

Peen-Forming Machine is One of the Largest

The Lockheed peen-forming machine is one of the largest in existence. Over-all bed length exceeds 85 feet. Two tables are provided, Fig. 3, and can be operated either separately, accommodating two panels up to 33 inches wide and 45 feet long, or as a single unit, accommodating a part up to 6 feet wide. The tables can be driven at infinitely variable speeds from 3 to 38 inches per minute. A secondary rapid traverse speed of 215 inches per minute is provided for quick part positioning.

All forming takes place within a rubber-lined peening cabinet that covers a 4-foot length of the work-piece. The cabinet interior is illuminated and the operators (one on each side of the cabinet to handle each table) view the work through windows. There are six air-blast nozzles for each half of the machine, as shown in the heading illustration. Each nozzle has a separate pressure regulator and shut-off valve for controlling peening intensity.

The two groups of six nozzles are mounted on separate bars that are oscillated by two Bellows air cylinders. Position and length of the stroke can be controlled for lengths up to 15 inches by setting adjustable stops. Speed of oscillation can be adjusted by an air-pressure regulator at each operator's station.

As might be expected, the work surface does not have a smooth appearance. In the most severe forming operations, the surface roughness may go as high as 250 micro-inches. If objectionable, the surface can be sanded to remove a maximum of 0.002 inch from the top of the peening marks. The work contour will not change appreciably, providing that no material is removed from the bottom of the peening dimples.

Use of the shot-peening installation is not restricted to the contouring of panels-it can be used for emergency salvaging operations. As an example, some 50-foot long wing beam cap extrusions were badly distorted as a result of machining (left, Fig. 4). This long, curving distortion in the T-shaped member was so severe that it could not be forced into the assembly jigs without causing ripples in the thin web section. The finish-machined parts would have been scrapped, but by shot-peening the cross of the tee they were satisfactorily straightened for use (right, Fig. 4).

Imperfect Shot is Rejected

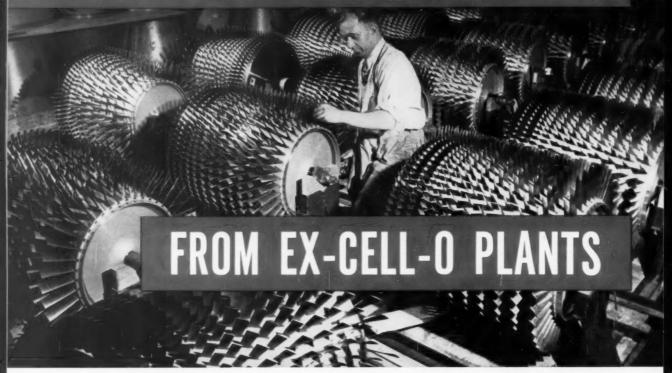
All shot is handled in a closed system that automatically rejects broken or under-size pellets before they can be used again. After peening, the shot drops to the bottom of the cabinet. A mechanical screw carries it out of the cabinet and into a bucket type elevator which raises it about 20 feet, then dumps it into a separator unit. The elevator can be seen by referring to Fig. 1. It is the upright structure shown at the right-hand side of the cabinet.

Rejection is accomplished within the separator unit by spreading the shot evenly over an inclined flat plate. As the pellets leave the end of this plate, the broken and light shot (which do not move as fast as the undamaged shot) are diverted from the main flow into a reject section by a knife. The reject section of the separator is connected to a dust collector (left-hand side, Fig. 1) that removes any dust or other small foreign particles from both the separator and the main peening cabinet.

After the acceptable shot has by-passed the separator knife, it passes through a screen-to prevent any large foreign particles from flowing into the nozzles-and into a hopper. There is a short horizontal run in each feed hose that restrains shot flow until the driving air is turned

on for each nozzle.

MILLIONS OF BLADES PER YEAR



Photo, courtesy of General Electric Co.

Ultra-modern facilities are employed to manufacture precision compressor blades for jet-aircraft engines from titanium and stainless-steel alloys on a mass-production basis

By E. HUGH JONES

Ex-Cell-O Corporation
Detroit, Mich.

RECISION parts and assemblies represent more than 40 per cent of the Ex-Cell-O Corporation's sales. Among many items for jet-aircraft engines, the company manufactures precision compressor blades in large quantities. A constantly increasing demand for such blades has made it necessary to expand existing facilities.

Compressor blades are now being produced at two Ohio plants—in Lima and Fostoria—and at a recently acquired plant in Elwood, Ind. These plants produce millions of blades per year from various stainless-steel and titanium-alloy forgings for the J-57 and J-75 turbo-jet engines made by Pratt & Whitney Aircraft and Ford's Aircraft Engine Division; Allison's J-71; General Electric's J-79; and the T-34 and T-56 turbo-prop engines

made by Pratt & Whitney Aircraft and Allison, respectively.

Also, pre-production and experimental blades are made for all these engine manufacturers. The blades vary from approximately 3/4 to 14 inches in length. A few of the different types of root forms produced are illustrated in Fig. 1. All surfaces of blades made from stainless-steel alloys are finished by grinding. Titanium-alloy blades, however, cannot be ground because of the danger of inducing surface cracks due to heating, and are finished by machining.

From 0.030 to 0.060 inch of stock is provided on the airfoil surfaces of the forgings for subsequent removal, and from 0.060 to 0.100 inch on the root surfaces. The forgings are first qualified by straddle-milling the root sections, milling the tip on the outer end of the airfoil section, drilling locating holes in the ends of the root, and center-drilling the tip. These operations are performed on a modified Ex-Cell-O double-end boring machine equipped with carbide milling cutters and high-speed steel drills.

The root forms of titanium-alloy blades are finished to size by broaching in two passes. A typical setup on a Lapointe 15-ton, 90-inch stroke broaching machine is seen in Fig. 2. With the forging clamped in the right-hand fixture, the dovetail form is broached in the first pass. Then, the part is transferred to the left-hand fixture, and the tongue form is completed in the second

A ram speed of 22 feet per minute is used to remove from 0.060 to 0.100 inch of stock with high-speed steel broaches. The pressure-angle surface on the root form is held to a tolerance of plus or minus 0.0003 inch. Also, the surface finish produced in broaching is maintained within 60 micro-inches. The broached surfaces are used for locating during all of the subsequent operations.

Airfoil surfaces, including leading and trailing edges and the fillets where the airfoil joins the root platform, are machined automatically on an Ex-Cell-O profile miller. As seen in Fig. 3, the blade root is clamped in a two-jaw chuck, while the locating tip on the outer end of the airfoil section is supported by a tailstock center. Steadyrest rollers are hydraulically held in contact with

the work to resist the cutting pressure, thus minimizing deflection of the blade.

The milling spindle is mounted at an angle on a slide beneath the work. A carbide-tipped milling cutter, made by the Continental Division of Ex-Cell-O, is rotated at a cutting speed of 400 surface feet per minute. The work does not rotate, but travels lengthwise across the milling cutter at the rate of 1/2 inch per minute. The chuck, tailstock, and steadyrests are locked hydraulically during cutting, but are released at the end of each stroke to permit indexing the work. Cutting and indexing are successively repeated until the blade has been indexed 360 degrees.

An accurately ground barrel-cam, mounted on the left-hand end of the machine work-head (Fig. 4), controls the vertical movement of the cutter to reproduce the required airfoil form. These precision hardened and ground cams are made from masters of laminated construction. The masters are made up of alternate aluminum and steel segments that are accurately finished on a template grinder and fitted together. The templates are made from enlarged glass layouts of various sections of the airfoil contour. The roll follower can be seen directly below the cam. From 0.030 to 0.060 inch of stock is milled from the airfoil surfaces in this operation, bringing the blades down to the high limits of the blueprint tolerances in the case of titanium blades. For stainless-steel blades, grinding stock is left on the work for subsequent removal.

Fig. 1. Various types of root forms produced on compressor blades. Titanium blades are finished by machining since grinding is not permitted.





Fig. 2. Root forms of titanium-alloy blades are broached in two passes-one pass for cutting the dovetail form and the other for completing the tongue form.

Since the titanium-alloy blades cannot be ground, they go directly to an Ex-Cell-O polishing machine, Fig. 5. Here, the airfoil surface is precisely semifinished by means of a resin bonded, silicon-carbide abrasive belt of 100 grain size that is traversed at the rate of 2700 feet per minute. The work is again held in a two-jaw chuck and supported by a tailstock center, with the contour controlled by a master cam. From 0.002 to 0.004 inch of stock is removed from the airfoil surfaces in this operation.

Airfoil surfaces of the titanium blades are finished on the Hammond six-station, automatic rotary machine seen in Fig. 6. The operator loads and unloads blades from the universally mounted, reciprocating work-holders at one station. As each blade is automatically clamped and hydraulically indexed to successive stations, it is polished by progressively finer abrasive belts. Two belts-one above and the other below the blade-are provided at each station. For one particular blade, the abrasive belts at successive stations are 80, 120, 150, 240, and 320 grit. At present, aluminum-oxide abrasive belts are used, but it is planned to change to silicon-carbide abrasive for future polishing operations.

Total stock removal in this finishing operation is about 0.0015 inch, and a surface finish of 8 micro-inches or less is produced. Each belt, supplied from a 50-yard long reel, is automatically indexed periodically to present a fresh abrasive surface to the blades. A light, straight oil is used as a coolant and to wash the abrasive particles

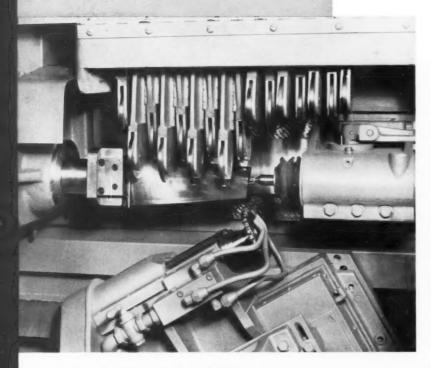
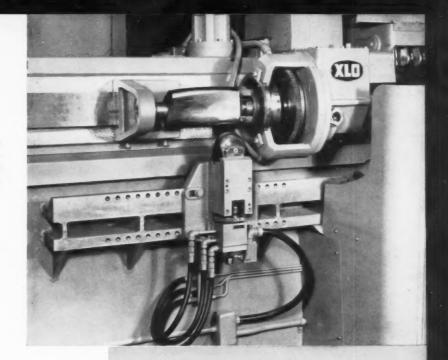


Fig. 3. Close-up view of a profile-milling machine for cutting the airfoil surfaces of compressor blades. Steadyrest rollers resist cutting pressure to reduce deflection.

Fig. 4. Precision cam on the left-hand end of the profilemilling machine work-head controls contour cut on the compressor blade forging.



away. This machine can produce up to 360 blades per hour.

Locating tips on the outer ends of the airfoil sections are sheared from the titanium blades on a Niagara 2 1/2-ton press. In this same operation, a radius is formed on the outer edge of the blade. It has been found unnecessary to heat the titanium blades, as satisfactory results are being obtained with cold-shearing.

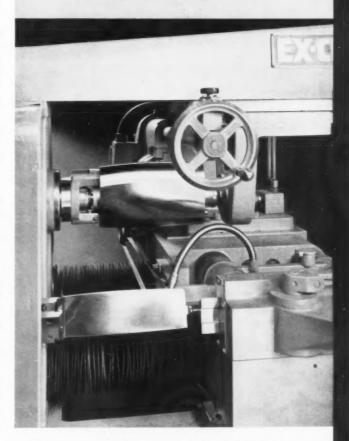
Stresses induced in the titanium blades during machining are relieved by heating to a temperature of 1050 degrees F. in a controlled-atmosphere electric furnace. The oxide film produced on the blade surfaces during stress-relieving is removed by Liquid Honing in the Vapor Blast four-station rotary machine shown in Fig. 7. Two blades are loaded at each station, one held by a spring clamp over the root to expose the airfoil section, and the other placed over hard rubber rollers and under a pad to expose the root only.

As the blades are automatically indexed to succeeding stations, they are blasted by an abrasive-water solution containing 14 gallons of 200-grit Pangbornite abrasive to 50 gallons of water, plus 6 ounces of a rust inhibitor. Two stationary guns blast the root sections, and two reciprocating guns blast the airfoil sections.

After etching the titanium blades in the acid bath seen in the foreground of Fig. 7, their root sections are further stress-relieved by peening. Steel shot 0.010 inch in diameter is used for peening. This operation is performed on a Wheelabrator slinger type blasting machine having a continuous belt conveyor equipped with sixty-two work-holding fixtures. The fixtures mask the airfoil sections of the blades while the roots are being blasted.

Compressor blades made from corrosion- and

Fig. 5. About 0.003 inch of stock is removed from the airfoil surfaces of titanium blades by polishing with a 100-grit belt traveling at 2700 feet per minute.



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Fig. 6. Six-station rotary machine for automatically finishing airfoil surfaces. Blades are completed at the rate of 360 per hour.

Fig. 7. Abrasive-water solution is blasted on titanium blades in this four-station rotary machine to remove the oxide film that has been produced during stress-relieving.



heat-resistant steels such as AMS 5613 and 5616 are heat-treated to a hardness of 45 to 48 Rockwell C, and drawn back to a hardness of 32 to 38 Rockwell C, prior to machining. After roughbroaching, the root sections of the stainless-steel blades are ground on Ex-Cell-O two-wheel formgrinding machines like the one shown in Fig. 8. Both sides of the root form are ground simultaneously in a completely automatic cycle. All that the operators are required to do is manually load and unload the work-pieces.

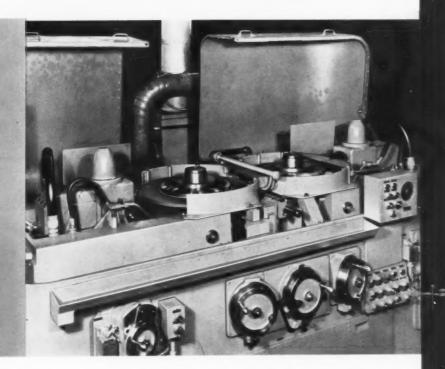
The blades are located and clamped in removable type shuttle blocks which reciprocate between the grinding wheels for a predetermined number of passes at an adjustable speed. At the end of each stroke, the wheel-slides feed in until they engage positive stops which control size. When the cycle is completed, the work returns to the loading position, coolant flow stops, the fixture is unclamped, and the feed mechanism is reset for the next cycle.

Vitrified-bond, aluminum-oxide abrasive wheels of 100 grain size are used. The wheels, 24 inches in diameter by 5/8 inch wide, are automatically trued after grinding three parts by two cam type diamond dressers. To change from one root to another, it is only necessary to install new dresser cams and grinding wheels of suitable width. A cutting speed of 600 surface feet per minute is used, and from 0.008 to 0.012 inch of stock is removed from each side of the blade root.

Steel blades are returned to the broaching ma-

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Fig. 8. Two-wheel form-grinding machine for finishing both sides of compressor blade root forms in a completely automatic cycle.

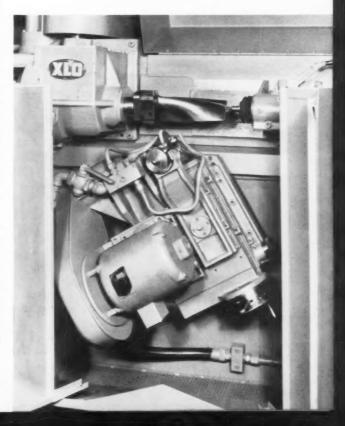


chines for finishing the tongue and stage surfaces between the roots and airfoil sections. Then, the airfoil surfaces are machined on profile millers similar to those used for titanium blades (Fig. 3). Grinding machines similar to the one seen in Fig. 9 are used to semifinish the airfoil surfaces. From 0.008 to 0.010 inch of stock is removed from each side of the blade in this semifinish grinding operation.

The operation of the airfoil surface grinding machines is basically the same as the profile millers except that the work rotates as it is traversed across the wheel at an adjustable rate. Cams and followers at the left-hand end of the machine work-head control the form ground on the blade. Work movement at the fillet (where the airfoil joins the root platform) is controlled by a face-cam, and a drum type cam controls the rise and fall of the work-head. Steadyrests are not required during grinding, because the blade is rotated and the pressure of the wheel is not sufficient to cause deflection.

Since the area of contact between the work and the grinding wheel is quite large on the broad faces of the blade, and relatively small at the leading and trailing edges, the work speed is automatically changed as the blade rotates. A vitrified-bond, aluminum-oxide abrasive wheel of 60 grain size is used. The wheel is 3 inches in diameter by 5/8 inch wide. After polishing and shearing off the locating tips, the blades are ready for inspection.

Fig. 9. On this airfoil surface grinding machine the stainless-steel compressor blade is rotated as it is being traversed across the abrasive wheel at an adjustable rate.



VAPOR BLASTING DEBURRS AND BLENDS MACHINED SURFACES



North American F-100D Super Sabre

Smooth, blended surfaces are obtained by spraying work-pieces with a mixture of water, abrasive particles, and compressed air. Process is continuous, the parts being carried through the machine by a conveyor system. The surface finish produced on wing panels can be varied to suit different specifications.

By RAY FURGESON, General Foreman Heavy Machining Department and

JOHN R. EGGUM, Tool Liaison Engineer Los Angeles Division North American Aviation, Inc.

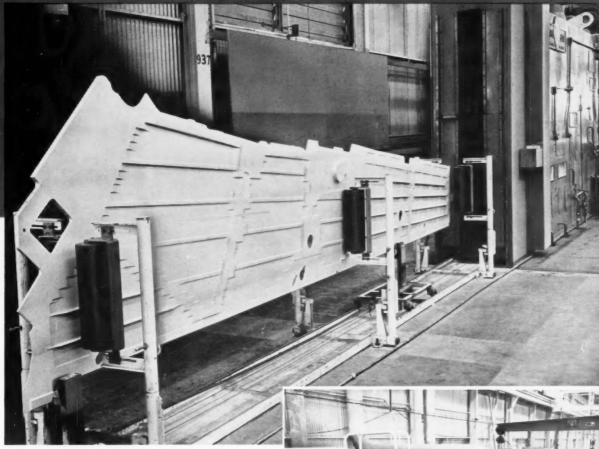
HE wing panel of a North American F-100D Super Sabre is an integrally stiffened one-piece structure that requires considerable machining. When completed, these cuts must be deburred and blended to meet the exacting tolerances specified.

Originally, such operations, being manually performed, were very time-consuming. Today, a 73 per cent reduction in labor cost is realized by deburring and blending these large wing panels in an automatic vapor-blasting machine, Fig. 1, made by the Vapor Blast Mfg. Co., Milwaukee, Wis. At the same time, a higher quality part is produced.

Vapor blasting, or Liquid Honing, as it is sometimes called, is accomplished by forcing water and an abrasive mixture through a nozzle by means of compressed air. The abrasive mixture in the resulting high velocity blast creates a cutting or peening action on the parts being processed. Different finishes can be obtained by using fine or coarse abrasives, or by adjusting the distance between the nozzle and the surface of the part. The medium-fine abrasive used for vapor blasting the subject skins removes any tool marks that have been produced during machining, as well as any burrs formed. Also, this processing leaves the metal with a smooth surface having a satin-like finish.

In processing a skin with the vapor-blasting equipment, the work-piece is first loaded onto a set of holding dollies that run on a track through

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the machine. Then, the operator hooks the dollies by means of a clamping device to a conveyor cable that runs between the tracks. A wing panel loaded on the dollies and ready to enter the machine is illustrated in Fig. 2. The cable travel can be regulated for any desired speed by adjusting the motor unit. The average speed when blasting wing skins is 17 inches a minute.

After the skin is placed on the dollies and started through the machine, the work-piece enters the area where the actual vapor blasting is performed. Along each side of the machine there is a vertical, oscillating slide that carries the spray nozzles.

Drive units for the slides are shown in Fig. 3. In moving along the track, the part passes in front of these oscillating nozzles which apply the blasting solution at a pressure of 100 psi.

Fig. 1. Automatic vapor-blasting machine is 41 feet long by 3 feet wide by 9 feet 9 inches high. Since the process is continuous, the length of part that can be vapor blasted is not limited by the machine.



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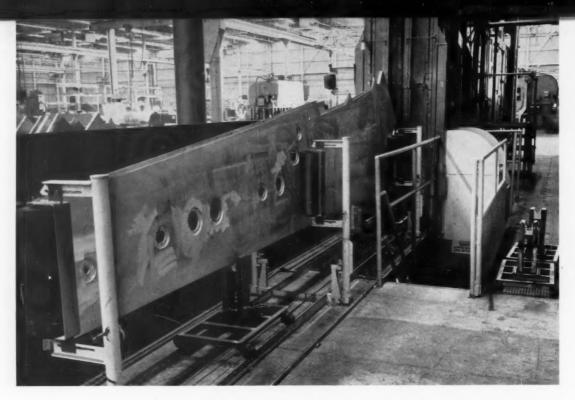


Fig. 2. For vapor-blasting, the rough skin is loaded on dollies attached to a conveyor cable. Part is ready to enter the blasting station. Rubber rollers support skin during its passage through the machine.

There are six nozzles on each side of the machine, 10 inches apart. They are located about 7 1/2 inches away from the surface of the skin as it travels through the blasting station. The nozzles travel 10 inches vertically on each stroke of the oscillating slide and, in addition, rotate back and forth to give an even blasting of the surfaces. A number of the spray nozzles are illustrated in Fig. 4.

The next station in the machine is a rinse station. Here, the part is washed with water under high pressure in order to take off the excess blasting solution. As the part enters this station, rinse water is sprayed onto the skin from both sides of the chamber. Two rinse stations, about 6 feet apart, wash the skin twice thoroughly before it enters the drying station. One of the rinse stations is shown in Fig. 5. The water used to rinse the skin is heated to about 110 degrees F. This helps to dry the part after it leaves the rinse station. The fluid drained from the rinse operation is collected in settling tanks to separate



Fig. 3. Twin drive units, one for each side of the machine, are cam-regulated for various speeds to oscillate the vertical slides which carry the spray nozzles. Slides operate simultaneously.

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Fig. 4. Three of six nozzles which are directed at each side of the part travel up and down on the vertical slide and, simultaneously, rotate back and forth in order to distribute the spray equally across the surfaces being blasted.



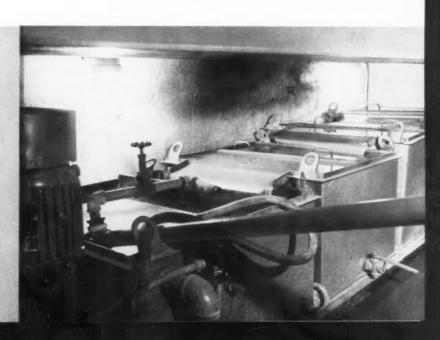
Fig. 5. Here, blasting solution is removed from the skin by high-pressure water sprays applied at one of two such rinse stations located 6 feet apart. Following this operation, the wing panel enters the drying section of the machine.

the abrasive from the water, both of which are re-used. Pit installation of settling tanks is illustrated in Fig. 6.

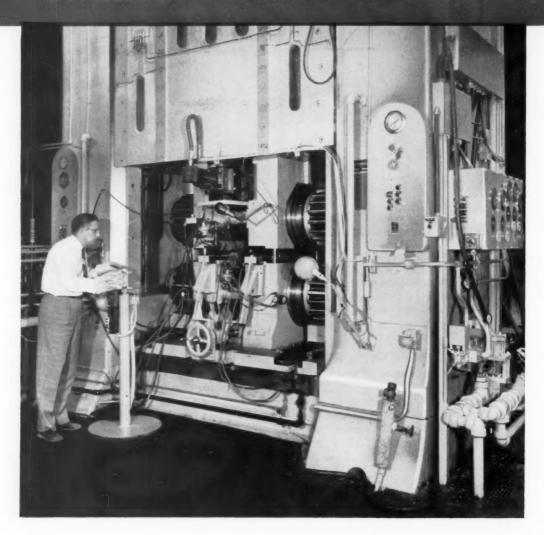
After leaving the rinse, the skin progresses to the drying station. In this final operation, the air is blown through electric heating elements and directed by baffles onto the part. The temperature of the air used to dry the skin is about 100 degrees F.

When the work-pieces emerge from the machine into the unloading station, they are placed in finger racks. In the heading illustration, a wing panel is shown ready for unloading after completion of the deburring and blending process. The entire vapor-blasting operation is completely automatic. The only handling function required of the operator is the manual loading and unloading of the machine.

Fig. 6. Settling tanks are installed in a pit below the machine for recovering abrasive carried away by the rinse water. After separation from the particles, the water is re-used.



TITANIUM FORMED AT FORD BY



NE important function of the Semi-Production Department at the Aircraft Engine Division of Ford Motor Co., Chicago, Ill., is the development of new or improved techniques for the manufacture of gas-turbine engine components. Proved methods are adopted for the quantity production of J-57 and J-75 turbo-jet engines—being built by Ford under a license agreement with Pratt & Whitney Aircraft Division of United Aircraft Corporation.

Among the unique devices used in the Semi-Production Department are heated folding dies and explosion restrike dies for inlet guide vanes. These vanes are made from 0.040-inch thick, com-

mercially pure titanium. Flat developed blanks, approximately 9 inches wide by 13 inches long, are folded to the required form on the die shown schematically in Fig. 1. The die is mounted in a standard Ford air fixture, provided with floor legs and three pneumatic cylinders. A formed tongue, having the required inside configuration of the inlet guide vane, is raised and lowered by the cylinder on top of the fixture. The side-forming members of the die are advanced and retracted by the other two cylinders.

Electrical resistance elements, made from Nimonic strip material and supplied with power from a standard welding transformer, heat the

HEATING, ROLLING, AND EXPLODING

By CHARLES H. WICK Managing Editor

side-die sections and platen to a temperature between 800 and 1000 degrees F. The required form on the leading edge of the inlet guide vane is machined into the die platen to a depth of 1/2 inch.

Flat vane blanks are placed on the platen, locating from tabs provided on the stamping. The top air cylinder is actuated to lower the formed tongue. This forces the blank into the formed groove in the platen and folds both sides of the blank upward. Then, air is introduced into the other two cylinders to advance the side-forming die sections and wrap the vane around the tongue. Heat is allowed to soak into the work during a 15- to 20-second dwell period to prevent spring-back of the material after forming.

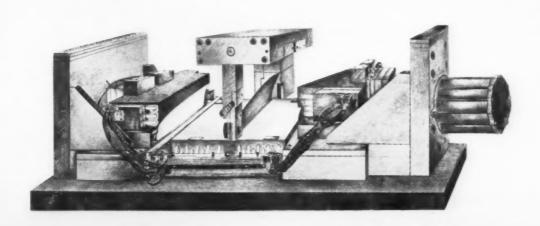
When the side dies and tongue have been retracted, a locking pin is removed from the tongue, and the tongue support arm (mounted on an overhead shaft) is pulled forward. Then, the folded inlet guide vane can be removed from the tongue. Very little pressure is required for this operation. In fact, all three cylinders operate on a standard air line pressure of 90 psi, but the operating valves are only opened enough to move the die sections and tongue.

Folded inlet guide vanes are resistance seam-welded along their trailing edges, and the tabs used for locating and welding purposes are removed. Using a method of explosion restriking introduced by Pratt & Whitney Aircraft, the hollow vanes are finish-formed. This explosion restrike method employs a shotgun shell to expand the metal to final form in the die shown disassembled in Fig. 2. This operation is also performed in a standard air fixture (similar to the one used for vane folding), with the punch and die members again heated to about 900 degrees F. by means of Nimonic resistance elements passing through holes in the die members.

The folded and welded vane is located in the lower die member (left), having the required airfoil configuration machined in its surface. The punch, machined to the contour on the opposite side of the vane, is lowered into place, and the assembly is allowed to soak for thirty to forty seconds to allow the titanium to reach temperature. Full air line pressure is applied to the 3-inch diameter piston to develop 7 tons pressure.

Then, an 8-gage shotgun shell (with shot removed, and calibrated at 10,000 psi for this particular size vane) is inserted in the back face

Fig. 1. Drawing of electrical resistance heated die in which inlet guide vanes of 0.040-inch thick, commercially pure titanium are formed from flat blanks.



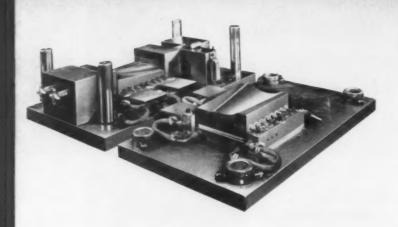


Fig. 2. Explosion restrike die for final forming (from inside) of folded and welded inlet guide vanes. The shotgun shell employed can be seen on firing chamber at top center.

of a sliding-block firing chamber. Water is circulated through the block to keep the shell cool before firing, as well as through the members surrounding the insulated die blocks. The chamber is then slid into place between blocks, and a string is pulled, Fig. 3, to trip the firing pin of a spring-loaded trigger mechanism. Gas pressure escaping from the firing chamber through an airfoil shaped opening in one face of the die bulges the titanium outward to the required shape.

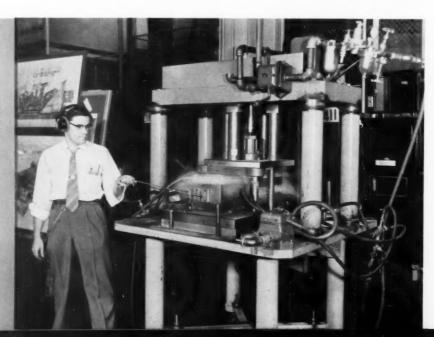
As seen in Fig. 3, the operator wears ear protectors to deaden the sound of the explosion. Since this illustration was taken, a box that fits over the air press is used to isolate the noise. In production, it is proposed to place this cartridge-actuated die in a 50-ton hydraulic press.

A novel method developed by the Semi-Production Department for producing compressor blades is considered of major importance because it is adaptable to mass production on existing presses. With this technique, heated upset blanks are roll-forged to produce the desired airfoil contour on a modified Lake Erie 1500-ton, vertical hydraulic press seen in the heading illustration and Fig. 4.

Ideal grain flow is produced, particularly in the highly stressed areas of the blades. Also, considerable savings in costly material are realized, since the airfoil contour is finished to print specifications in rolling, and no further machining is required except on the root. Previously, forged compressor blades had to be contourmachined all over, and then ground and polished. At present, compressor blades of Rem-Cru AT-110 titanium and AMS 673 corrosion- and heat-resistant steel are being rolled in this way. It is expected that production rates of 150 to 200 per hour will be possible; the exact rate depending on the size of the blades, the material being rolled, and the number of passes required.

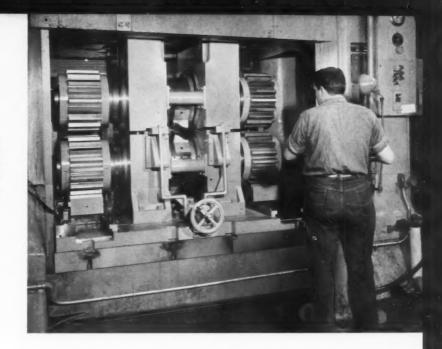
Blade forming is accomplished by passing the heated upset blank between two die rolls which are mounted, together with the roll driving gears, on horizontal axes in the die area of the triple-action hydraulic press. A duplicate set of four spur gears (two die roll drivers and two idlers), having a pitch diameter of 19.00 inches and a diametral pitch of 1, is provided on each side of the die rolls. The two gears for driving the lower die roll, as well as the two drive gears for the

Fig. 3. Firing pin of spring-loaded trigger mechanism is actuated by pulling string. The operator wears ear protectors to deaden the sound of the explosion.



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Fig. 4. Front view of 1500-ton, triple-action hydraulic press used to roll steel and titanium compressor blades from heated upset blanks at rates up to 200 per hour.



upper roll, can be seen in Fig. 4, while the two intermediate idler gears on each side of the rolls are visible from the back of the press, Fig. 5.

Each lower drive gear is rotated by a 10-inch wide, reciprocating gear rack that is mounted on the press bed and powered by a 115-ton, 12-inch diameter by 16-inch stroke hydraulic cylinder. Oil under a pressure of 2000 psi is supplied to the two rack-actuating hydraulic cylinders from the die-cushion cylinder in the base of the press. Power from the lower die roll drive gears is transmitted through the idler gears to the upper drive gears.

Linkage provided between meshing gears in each set maintains a fixed center distance between each pair of adjoining gears. While the axes of the lower drive gears are fixed, the axes of the idler gears are moved to the front or back of the press as the upper drive gears (attached to the press inner ram) are raised or lowered. The idler gears also move up and down (one-half the distance of the upper drive gear) as the positions of the upper drive gears are changed.

A total of 1500 tons pressure, taken from the upper ram cylinders of the hydraulic press, is used for the initial impression of the heated compressor blade blanks, and to keep the upper die roll axis in a fixed position during rolling. Downward movement of the press ram and upper die roll is positively controlled by four stop wedges, two at the front and two at the back of the press. If more than one pass is required to complete the roll-forming of the blade, the opening between die rolls is reduced by rotating a graduated handwheel connected to the four stop wedges.

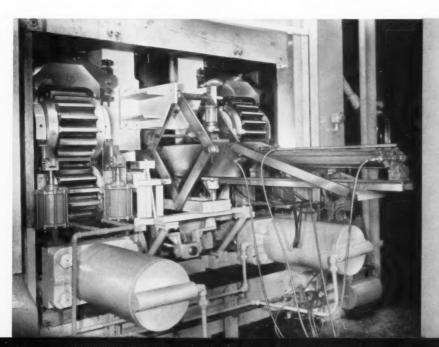


Fig. 5. Rear view of press seen in heading illustration and Fig. 4 shows the two large hydraulic cylinders for reciprocating the racks used to rotate the die rolls.

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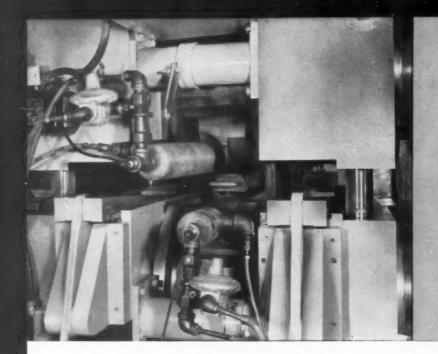


Fig. 6. Gas flames are used to heat blade form inserts on die rolls to a temperature between 900 and 1000 degrees F., prior to the rolling of compressor blades.

The compressor blade blank is gripped in fingers on the end of a feed arm that is reciprocated between the die rolls by a 3-inch diameter by 34-inch stroke air cylinder mounted on the rear of the press (Fig. 5). Prior to rolling, the die roll inserts are heated to a temperature of about 950 degrees F. by means of gas burners, as seen in Fig. 6. The blade form inserts can be quickly removed from the die rolls by simply loosening socket-head cap screws. The adjustable stop wedges can be seen on either side of the die rolls in this illustration.

Developed blanks for producing compressor blades are sheared from strip stock, heated to approximately 1200 degrees F. on one end, and upset to form the root sections. The upset blank is clamped in the feed-arm fingers of the rolling press and fed into an induction heating coil, seen at the right in Fig. 7. Here, the blank is heated

to about 1400 degrees F. for optimum rolling conditions,

With the die roll inserts preheated, and the upset blank raised to the proper temperature, the cycle-starting button is depressed. This actuates the feed-arm air cylinder, which retracts the hot blank into position for rolling. As the blank reaches rolling position, the feed-arm trips a limit switch to set the press in motion. The press ram descends until the stop wedges are contacted, causing the die roll inserts to form the initial contour. As the pressure builds up on the ram, the two rack cylinders are actuated to transmit rotary motion to the die rolls.

The feed-arm retracts the blank toward the rear of the press as the die inserts roll the airfoil contour. Upon completion of the blade-rolling cycle, the press ram automatically rises to open the die inserts, and the feed-arm returns to its

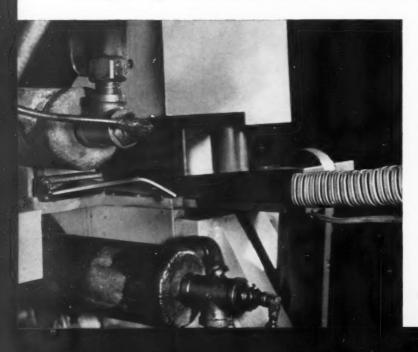
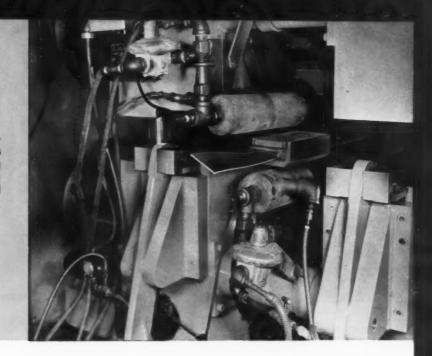


Fig. 7. Compressor blade blank, clamped between fingers of feed-arm seen at left, is advanced into induction coil (right) for heating to 1400 degrees F. prior to rolling.

Fig. 8. Feed-arm returns completed blade to front of press for unloading after rolling cycle. If second pass is required, blade is reheated and cycle repeated.



starting position, Fig. 8, for unloading the completed blade from the front of the press. Simultaneously, the racks are retracted to reverse the rotation of the die rolls to their starting position. Longer and thicker compressor blades requiring a second pass are reheated, and the cycle is repeated with the stop wedges adjusted to permit more travel of the ram.

Die inserts for rolling of compressor blades are made from a heat- and abrasion-resistant T-15 grade of high-speed steel containing 13 per cent tungsten, 4 1/4 per cent chromium, 5 per cent vanadium, and 5 per cent cobalt. After hardening, the inserts are drawn back to a hardness of 50 Rockwell C to prevent brittleness. This is necessary because of the chilling effect of the hot work on the cooler die. Asbestos insulation is provided between the rolls and die inserts to prevent the loss of heat to the rolls. No lubrication of the die inserts is used at present, but some type of coating may be necessary for the production of certain titanium-alloy blades to prevent hydrogen embrittlement.

The curved die inserts are made from linear two-dimensional masters on a Keller automatic, tracer-controlled milling machine, Fig. 9, by means of an ingenious attachment designed by engineers of the Semi-Production Department. The attachment fits on the upper and lower spindles of the three-spindle Keller machine, while the die insert to be cut is held in a fixture keyed to a pivoting shaft in the attachment.

A gear sector, also secured to this same shaft,

meshes with a rack secured to the attachment box-frame, which also carries the master. Thus, when the stylus is traversed over the master, the rack-and-gear arrangement transfers linear to rotary motion, and swings the insert through the required circular path. The cutter, mounted on the center spindle of the machine, remains perpendicular to the surface being machined.

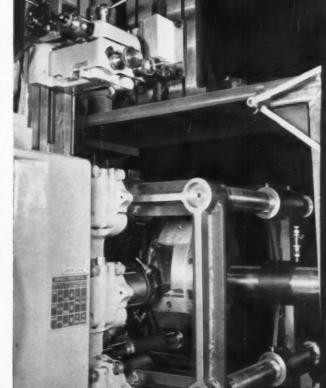


Fig. 9. Special fixture mounted on a three-spindle, tracer-controlled milling machine for cutting curved die inserts from two-dimensional masters.

MACHINERY, July, 1957-189

BUILDING CONTAINERS FOR NIKE MISSILES

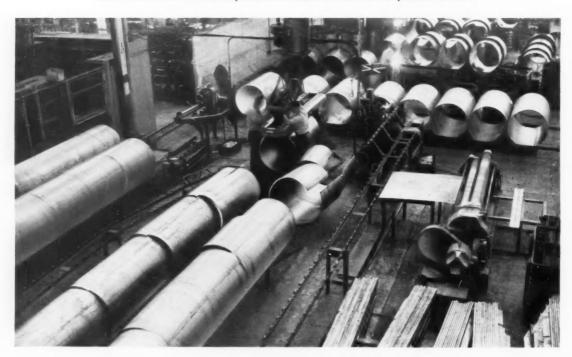
By CHARLES O. HERB, Editor

NE of the most important defensive implements of warfare developed in recent years by the Ordnance Corps of the United States Army is the Nike-Ajax anti-aircraft missile. Bases for protecting strategic points by means of these missiles in case of a national emergency are being established both at home and abroad. Missiles supplied to these bases must be guarded against corrosion or other de-

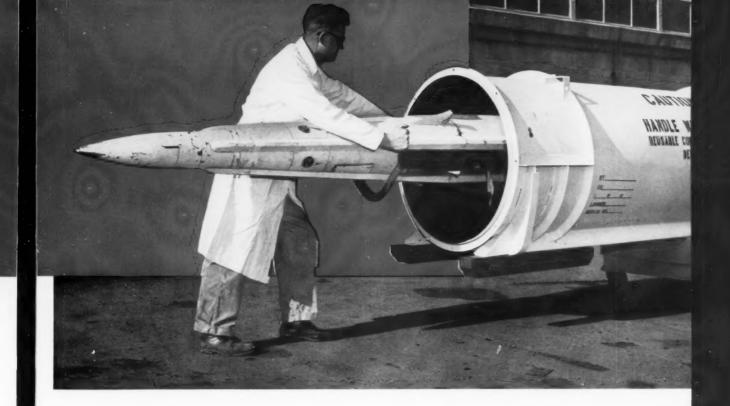
terioration of the war-head and the remaining components.

To provide this protection, each Nike-Ajax missile is sealed in large, airtight, waterproof containers. While in use, these containers have an internal air pressure that is maintained at from 5 to 10 psi. This air pressure prevents outside air or moisture from leaking into the container at any point. Provision is also made on the container

Fig. 1. General view of the department fabricating Nike-Ajax containers. Steel sheets are here rolled into cylinders and then welded into complete containers.



190-MACHINERY, July, 1957



to enable periodic checking of the internal air pressure.

Another purpose of the container is to prevent damage to any Nike part while the missile is in transportation. Each container, therefore, consists essentially of a long, large-diameter cylinder that is fitted at each end with a rubber-gasket sealed head. Internally, there are rubber shock absorbers and rubber-mounted supports that are welded to the cylinder. There is also a track of structural steel members to facilitate sliding the Nike in and out of a cylinder. Externally, the containers are provided with reinforced rings and longitudinal stiffeners. Also, a flange is attached to each end for sealing purposes. When assembled, a heavy rubber gasket is placed between each of these flanges and the head that is bolted to it.

The John Bean Division of the Food Machinery and Chemical Corporation, San Jose, Calif., has been fabricating Nike-Ajax containers for over two years. Most of the work consists of welding, as there are approximately 4000 inches of weld on each container. These containers are 34 inches in diameter and over 20 feet long. Their bodies are constructed of No. 14 gage hot-rolled mild steel.

Each container is fabricated from five sections that are rolled into cylindrical shape from trimmed flat sheets by the equipment seen at the right in Fig. 1. They are immediately transferred to the automatic Unionmelt welding machine seen in Fig. 2 for welding the longitudinal seam. The sections are then crimped on one or both ends to permit telescoping the ends of different sections in assembly.

Next, shock-absorber mounts are carefully located within the sections by using a fixture, and the mounts are attached by applying Lincoln arc-welding equipment. The sections are then delivered to cradle type fixtures such as seen in Fig. 3 for assembling and squeezing together to obtain the desired over-all length. The sections are located radially by entering cam-operated dowels into holes previously pierced in the circumferential rings.

After the sections have been located radially, the assembler uses the long crank handle to force a cross-member against one end of the container to push three sections into one another. Arcwelding operations such as illustrated in Fig. 4 are performed with the assembly in other cradle rotating fixtures. Later, the sections are taken to a fixture similar to the one in Fig. 3 where the remaining two sections are added to the assembly.

The formed angle-iron "gaskets" on the ends are welded completely around the containers and along both contacting edges of the angle-irons. The gasket rings are attached by Unionmelt welding. The reinforcing rings are alternately arc-welded on opposite sides, the entire welding



Fig. 2. Automatic Unionmelt welding machine employed for producing longitudinal seam welds in Nike container sections.

bead being equal to the circumference of the container. The container is fixture-welded to its base and is then moved to rolling fixtures to complete the required detail welding. After welding, the containers are sand-blasted and then put through water and pressure tests. Upon completion of the pressure test, the containers travel on tracks through the cleaning, painting, assembling, and stenciling operations.

In forming structural pieces for the tracks, use is made of the Cincinnati shear shown in Fig. 5 and the Cincinnati press brake shown in Fig. 6. Typical parts formed on the brake are seen in the right foreground. They are formed from 3/16-inch, hot-rolled plates.

The press brake in Fig. 7 is used for simultaneously punching the holes on opposite sides of the reinforcing rings that are used for locating purposes in assembly of the containers, as already described. Use is made of a work fixture designed for easy locating and clamping.

After all welds (both internal and external) have been sand-blasted, the containers are subjected to the water test illustrated in Fig. 8, the heads having been assembled. Air at a pressure of 20 psi is forced into the container prior to the test, so that improper welds will be indicated by air bubbles in the water.

Afterward, Army inspectors perform a very stringent twenty-four-hour test during which there can be only a very slight drop of air pressure. An allowance is calculated for barometric and temperature changes.

When the containers have passed these tests, the heads are removed, and both the containers and the heads are subjected to cleaning and phosphatizing operations. An Oakite No. 21 solution is used in the cleaning step. Both the con-



Fig. 3. Cradle type fixture used for assembling the various container sections in proper radial and longitudinal positions.

Fig. 4. In a typical arc-welding operation welder is attaching one of the angle-iron rings against which a rubber seal is clamped when the head is installed.



Fig. 5. Steel sheets are cut to the proper width on this shear in preparation for forming structural members for the Nike containers.

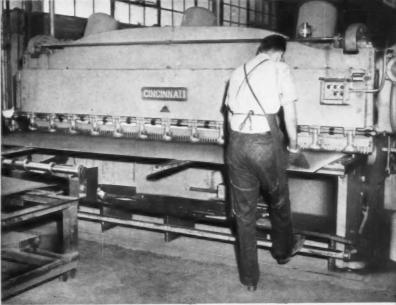
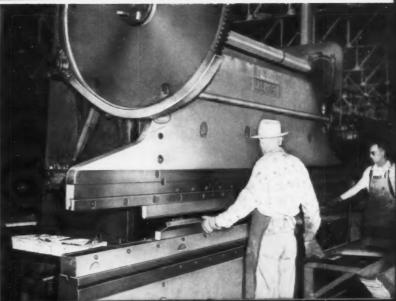


Fig. 6. Press brake which is used to form structural stiffeners that are subsequently welded to the Nike containers. Typical parts formed on this machine are seen at lower right.



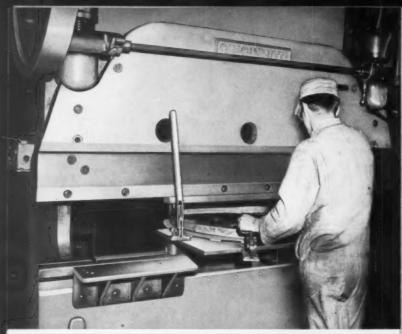


Fig. 7. Another press-brake operation in which holes are pierced in rings that serve to strengthen the container circumferentially.

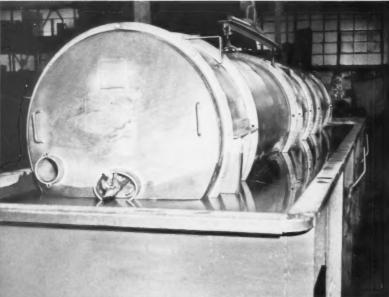


Fig. 8. After completion of all welds, each container is subjected to a water test to make certain that it has been made completely airtight.

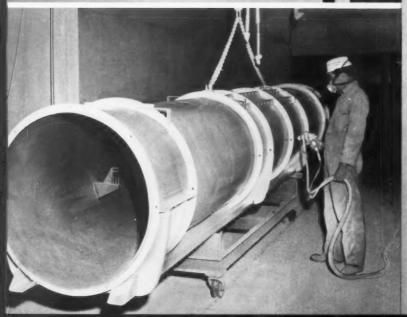


Fig. 9. A zinc-chromate primer is applied all over the Nike-Ajax containers, and then they are spray-painted olivedrab internally and white on the external surfaces.

tainers and heads go through a drying furnace prior to painting.

The containers are spray-painted an olive-drab color internally and white externally; the latter step in the process is shown in Fig. 9. The first step in the painting process, however, is to apply a zinc-chromate primer all over. Cleaning, drying, and painting of the heads are performed with the heads moving continuously on an overhead conveyor. The final operations are to assemble a carriage for convenient loading and unloading of the Nike missiles, reassemble the heads, and stencil essential information on the containers in black paint.

Tape-Controlled Drilling of Holes Around Circles

BOTH milling and drilling operations are performed on a Gorton vertical milling machine equipped with a Micro-Positioner table in the Torrance plant of the El Segundo, Calif., division of the Douglas Aircraft Co., Inc. The illustration shows this machine being used for the accurate drilling of ten holes in a cross-feed fitting for fuel tanks, an operation that must be duplicated many times in producing considerable quantities of these fittings.

Eight of the holes, having diameters of 0.300 to 0.316 inch, are equally spaced around a 2.750-inch diameter circle on the end flange. The center-to-center distance between the holes must be correct within 0.010 inch, and the tolerance on the location of the center line for the initial hole, within one-half degree of arc. Two holes, 0.246 to 0.260 inch in diameter, are also drilled through ears located near the middle of the part. For this drilling operation, the part must be set up a second time on the machine table with the externally threaded end uppermost. The part is made from aluminum bar stock.

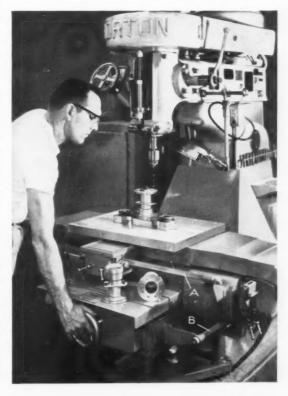
The work is correctly positioned for drilling the successive holes by longitudinal and transverse movements of the Micro-Positioner table under the control of two steel tapes. One tape spans across the front of the table, as seen at *A*, for controlling the longitudinal table movements, and the second tape extends from the front to the back of the table, as indicated at *B*, for controlling the transverse settings of the work.

Indentations on the tape, which are made at the time that the job is set up for the first time, act on a sensing mechanism to stop the table movements each time the work is located in a desired position. The table movements are automatically governed by an electric combination clutch and brake, which starts and stops lead-screws to impart the longitudinal and transverse movements to the table. The indentations are made on the tape with an accurately laid out but undrilled piece, properly located on the table. Two solenoid-actuated pins are employed

to indent the tape at each required point. Top and bottom rows of indentations are made on each tape so as to control right- and left-hand movements in the case of tape A; in and out movements in the case of tape B. All movements of the table are directed from a control panel.

The Micro-Positioner table does away with the necessity of using jigs on production work. The table has a fast traverse of 90 inches per minute and slows down to a feed of 6 inches per minute as each position point is neared.

Vertical milling machine equipped with Micro-Positioner table that facilitates the duplicate drilling or milling of work-pieces.



HOT-STRETCHING ELIMINATES SIX FORMING OPERATIONS



Northrop "Snark" SM-62 Pilotless Guided Missile

By BARTLEY MALONEY

Fabrication Tooling Engineer Northrop Aircraft, Inc. Hawthorne, Calif.

INTEGRAL heating of aircraft structural shapes as they are being formed on a stretch press has eliminated six out of seven steps involved in conventional stretch-forming of parts at Northrop Aircraft, Inc., Hawthorne, Calif. Moreover, the ten hours of bench work ordinarily required on stretched parts for each hour of machine work are not necessary with parts produced by the new process.

A general view of the stretch press used for this work is shown in Fig. 1. The die is heated by thermostatically controlled, 110-volt electrical cartridges which are set into the die body. The work-piece is heated by a 440-volt resistance heater having terminals that are attached adjacent to the jaw inserts of the press. The electrical current delivered through the part is varied to suit the part thickness. A controlled input from 0 to 50 kw may be maintained as needed. Parts may be heated over a wide range of temperatures up to 1500 degrees F. This temperature range allows for processing all metals now in common use, including titanium.

When the part has reached the desired temperature, it is stretched in the regular manner to an automatically controlled amount of elongation. Equal temperatures are maintained for both the die and the work to prevent cooling of the part upon contact with the die. In other words, a part is heated on the machine prior to the starting of the operation. If the temperature were different for the work and the die, stresses would be built up within the part on the cool side. The high precision of parts formed in this manner is indicated by the fact that a feeler gage only 0.002 inch thick cannot be passed between the part and the die when the finished and trimmed part is replaced against the die.

Parts formed in this manner have no residual stresses such as those set up in cold-forming, and they may be machined after forming without causing the part to "rainbow" or warp. Stretchforming dies used in the new process are made to the net dimensions of the work rather than under size, as is customary, since no spring-back occurs in the work. In Fig. 2 is shown a stressfree ring that was produced by forming two aluminum T-sections into semicircles and then welding them together. A fringe advantage that accrues with the process is that aluminum in the

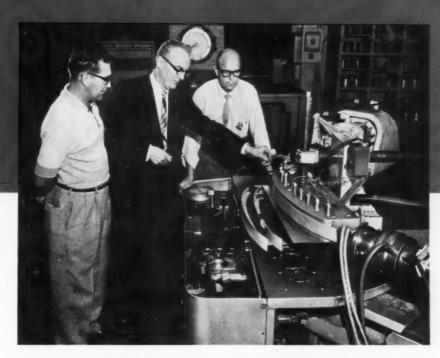


Fig. 1. Stretch-forming press equipped with a thermostatically heated die-block and having provisions for heating the work prior to forming operations, which enables the production of stress-free stretched components.



ST condition can be stretch-formed. This is a definite aid to volume purchasing and simplification of inventories.

The six operations that have been eliminated by stretch-forming parts with the new process include preforming of parts, solution heat-treating, age heat-treating, checking and straightening after aging, hand-forming, and storage in refrigerated boxes while awaiting the stretch-forming operation. This process will be made available to industry through licenses obtained from the Northrop Associated Products Department.

Fig. 2. A stress-free formed ring being held by the author. This ring was produced by welding two hotstretched semicircular aluminum T-sections together.



Short-run quantities of magnesium aircraft skins can be formed quickly and economically by taping flat blanks to formed aluminum skins and subjecting the assemblies to a combination of vacuum, pressure, and heat.

By H. F. YOUNG
Production Engineering Manager
Avro Aircraft Ltd., Toronto, Canada

NOVEL method of forming magnesiumalloy aircraft skins has been developed by Avro Aircraft, utilizing the company's existing autoclave equipment. While magnesium can be formed by the same general methods used for other metals, production is complicated by the need for heating. Furthermore, to achieve consistently good results, the heat must be applied evenly.

The temperature range for forming magnesium alloys generally varies between 300 and 600 degrees F. Certain alloys are readily formable at the lower end of this temperature range on presses and drop hammers. Such operations are relatively fast, since once the blanks are brought up to forming temperature, there is little time

lost before the blanks are positioned and the forming operation completed.

With these methods, it is seldom necessary to provide permanent heating facilities within the dies. If long production runs are not required, and the chill is taken from the dies by preheating, satisfactory parts can be produced by simply heating the magnesium blanks. In stretch-wrap forming, however, more time is required since both the form-block and work blank are heated.

To solve the problem of economical, small production runs, Avro engineers tried forming in an autoclave—which has built-in heat and pressure supply—with surprisingly good results. The autoclave, or "pressure cooker," was purchased originally for metal-to-metal bonding, which is used

MOLDS MAGNESIUM SKINS

extensively in building the company's supersonic Avro Arrow airplane. The autoclave, 7 feet in diameter by 25 feet long, is capable of developing pressures up to 200 psi, and a maximum temperature of 450 degrees F. Present metal-bonding practice requires a pressure of only 100 psi, and

a temperature of 350 degrees F.

In forming magnesium-alloy aircraft skins, it is first necessary to make an aluminum master. Such masters are formed from 1/8-inch thick 24S-O aluminum sheets by rolling or pressing to the required contour. The contour is carefully checked by means of a plaster model or templates. Special care is taken to insure that the surfaces of the formed aluminum master are free from imperfections, as even minor faults will be reproduced on the magnesium skin.

A flat magnesium sheet is placed on the formed aluminum part and secured with masking tape, as seen in Fig. 1. This assembly is wrapped in felt blankets and enclosed in a polyvinyl alcohol bag which has an outlet for a vacuum attachment and thermocouples. The purpose of the felt is to protect the plastic bag from being punctured by the edges or corners of the metal sheets. The bag itself serves to prevent the increasing pressure in the autoclave from getting between the sheets, and thereby offsetting the clamping action of the high-pressure air.

As the air is being exhausted from the sealed plastic bag, Fig. 2, the magnesium sheet is pressed down by hand to conform with the contour of the aluminum master. Holding the materials together during evacuation of the air prevents the felt and plastic from being sucked between the two sheets. With air pressure holding the magnesium to the aluminum form, the thermocouple lead from the plastic bag is attached to a temperature recorder to accurately control both the time and temperature.

The bag, with its contents and thermocouple and vacuum connections, is placed on a work tray and rolled into the autoclave, as seen in the heading illustration. When the door has been

Fig. 1. Initial step in forming magnesium-alloy aircraft skins is to tape a flat magnesium sheet to a formed aluminum master.





Fig. 2. Vacuum connection is being made to polyvinyl alcohol bag containing magnesium-sheet and aluminummaster assembly that has been wrapped in felt blankets.

closed, air is continuously exhausted from the bag by vacuum pump. Simultaneously, the temperature is raised to 300 degrees F. by means of steam coils in the autoclave, and then to 350 degrees F. with electrical resistance heaters. This heating cycle takes 25 minutes, while the pressure is maintained at 85 psi. Then, the assembly is cooled to about 140 degrees F.

Upon the completion of the curing cycle—requiring approximately 45 minutes—the assembly is removed from the autoclave. The now brittle vinyl bag is stripped off, the vacuum and thermocouple attachments are disconnected, and the felt is removed. A completed magnesium skin and the aluminum form are shown in Fig. 3. The plastic bag is, of course, only good for one forming operation; but the felt can be used several

times, and the aluminum master, permanently.

Although autoclave forming of magnesiumalloy skins cannot be considered as a highproduction method, it has proved most successful for short-batch requirements. A major advantage of the process is that normal amounts of metal-tometal bonding work can be accomplished simultaneously in the same autoclave—the pressures and temperatures required are the same.

Avro's production engineering staff anticipates that with suitable future development, it will be possible to perform the process with a heated fixture having the necessary provisions for the application of vacuum, and an air pressure bag to set the magnesium to shape. With such a setup, the autoclave could be used more extensively for bonding.



Fig. 3. Completed magnesiumalloy skin (left) and aluminum master from which it was formed in autoclave. Aluminum master can be re-used.

200-MACHINERY, July, 1957

TOOL ENGINEERING Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Drill Jig for Shaft Collars of Various Proportions

By CLIFFORD T. BOWER, London, England

A drill jig that can hold any cylindrical component within a fixed range of outside diameters and widths is here illustrated. Parts are clamped on their outside edges between two plates-one having a conical recess, and the other, a V-groove. The tool was designed for drilling and tapping set-screw holes in several sizes of collars for use on steel shafts.

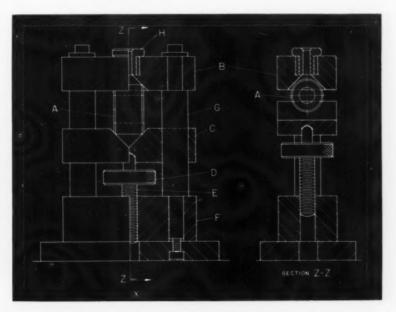
Instead of locating the work-piece by the bore, each collar A is positioned and clamped by means of its outer edges. To provide a better bearing surface, these edges should be given a 45-degree chamfer. A conical recess in the upper jig plate B centers each collar automatically. The adjustable lower jig plate C could have been provided with a similar conical recess, but the V-block shape was chosen since it resists the turning torque that is produced during the drilling and tapping operations.

In use, a collar is loaded into the jig by rolling it along the V-groove and simultaneously raising this lower jig plate to clamp the piece by turning the knurled knob D on the elevating screw E. The lower jig plate can be raised rapidly, as screw E has a coarse thread and turns freely in the tapped hole in the base F. A light clamping pressure is required to hold the work. Two supporting posts G for the upper jig plate also act as guides for the lower jig plate.

The half-section view X of the jig shows a large collar in place for drilling, while section Z-Z shows the jig with a small collar in position. As all collars required the same size set-screw, a single slip bushing H that is removed during tapping is used for guiding the drill.

This type of drill jig can also be adapted for drilling and tapping components such as spherical knobs.

A number of sizes of shaft collars can be drilled and tapped for set-screws in this drill jig. Fixed, upper jig plate (B) has a conical recess that centers each work-piece.



Semi-Automatic Feeding Device for Second-Operation Dies

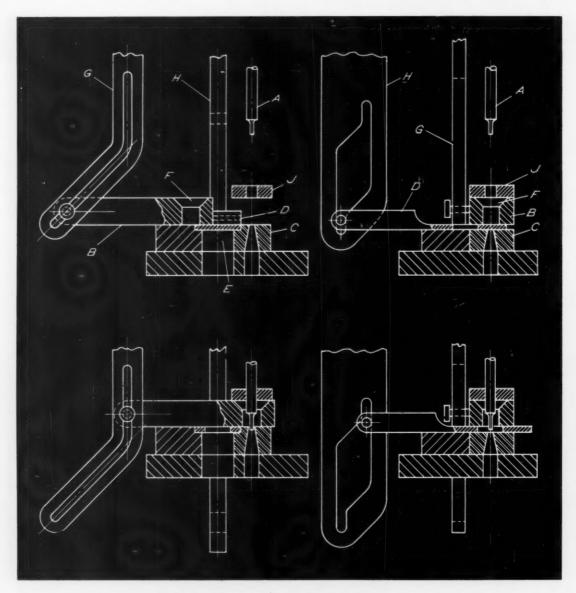
By FEDERICO STRASSER, Santiago, Chile

Second-operation dies employed for piercing, shaving, or trimming often have feed-slides to transport the blank to the work area. The same device also provides a means of removing the finished piece from the die. These slides may be manually operated or cam-operated by means of press-ram action. A simple but efficient cam-operated die-feeding mechanism that provides automatic work-piece ejection is here illustrated.

When the press ram and punch A are at the top

of their strokes, as seen in the two upper views of the diagram, feed-slide B is outside the working area of die C. At the same time, an auxiliary slide D, mounted at right angles to the feed-slide, covers the work-piece escape hole E.

With this arrangement, a blank dropped into the recess F in the feed-slide is pushed horizontally by cam G into the piercing position and pierced on the down stroke of the ram. Just prior to the actual piercing, cam H activates the auxil-



On upward stroke of press ram, feed-slide (B) allows work-piece (not shown) to escape through hole (E) previously uncovered by auxiliary slide (D).

iary slide to uncover escape hole E. The two lower ing this movement the work-piece passes over and views show the relative positions of the two slides with the punch fully descended.

On the upward stroke of the press ram, the part is stripped from the punch by stripper J and is then carried from the die by the feed-slide. Durthrough the escape hole in the auxiliary slide. A conveniently placed chute or bin receives the finished work. The auxiliary slide returns to its starting position at the end of the upward stroke, thus covering the work-piece escape hole.

Milling Fixture Holds Spindles Vertically

By F. C. Elmo, Dayton, Ohio

To mill two slots across the nose end of small spindles, a fixture was designed to support the work vertically. A drawing of the part is shown in Fig. 1. The slots, 0.040 inch wide, are at right angles to each other. They are cut with an arbormounted circular saw. The fixture itself is held on a Hartford Super-Spacer, so that it can be rapidly indexed and the two slots milled in sequence.

It was decided to design the fixture to grip the spindle on its main body area, rather than on the nose, because of the tendency of the nose to collapse as the slots were produced. A cross-section of the fixture appears in Fig. 2.

Spring collet A is bored internally to receive the spindle. Four splits B in the collet, 90 degrees apart, provide the necessary closing flexure and also give the saw access to the surfaces to be cut. Work is loaded into the bottom of the collet, which is first removed from locator C.

Spring-loaded plunger D thrusts the work up-

ward until its shoulder E is against a step in the collet bore. Then clamp F locks the plunger in position, and threaded ring G is slipped over the collet and engaged with the locator. The inside of the ring and outside of the collet have corresponding tapers. Tightening the ring, by means of hand spokes *H*, compresses the collet, and thus secures the spindle for the milling operation.

Casting of 32-Inch Diameter Ingots

In the article "Latest Techniques in Extruding Aluminum," published in May MACHINERY, it was incorrectly stated that Kaiser Aluminum & Chemical Corporation had cast ingots up to 32 inches in diameter under a manufacturing methods development contract awarded by the Air Materiel Command. This method was developed by the corporation's Department of Metallurgical Research under a program of its own.

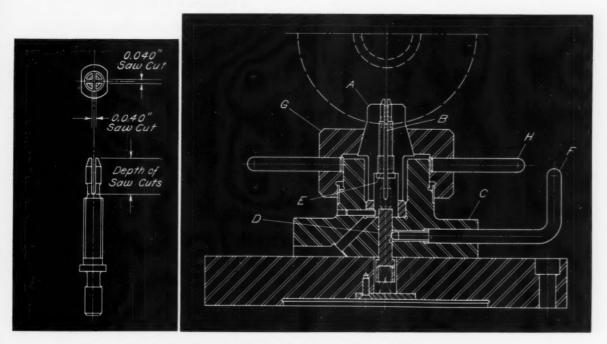
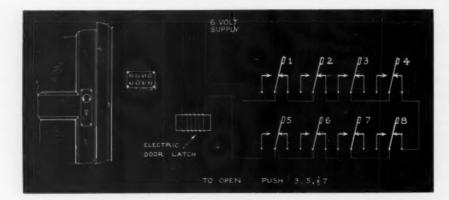


Fig. 1. (Left) Location of the two slots in the nose end of the spindle is here illustrated. Fig. 2. (Right) Spindle is secured when collet (A) is compressed by turning ring (G).

SHOP KINKS



The eight push-buttons, wired in series, provide 256 possible combinations of operating the latch. Wired as shown, pressing push-buttons 3, 5, and 7 will open door.

Push-Button Combinations Control Door Latches

By CLINT McLAUGHLIN, Rockaway Beach, N. Y.

To lock its tool cribs and storerooms, a machine shop devised an interesting push-button system. Problems of keeping track of keys for doors and changing locks when keys were lost have been eliminated with this system.

The accompanying illustration shows how the new system works. Door hardware includes the usual electric door latch. Near the jamb is a panel of eight push-buttons, wired in series to the latch. Buttons are the type that can be connected in either a normally open or a normally closed position. To open the door, the buttons which are wired normally open must be pushed,

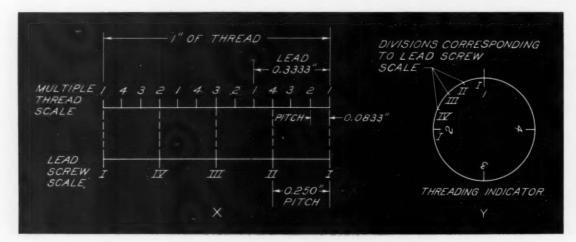
while the buttons which are wired normally closed must not be pushed.

In the drawing, buttons 3, 5, and 7 must be pushed. There are 256 combinations possible with eight buttons, but only one of them will open the door. To change the combination that will open the door, it is only necessary to switch a few wires.

Simple Method for Cutting a Quadruple Thread

By CECIL H. SMITH, Galt, Ontario, Canada

A quadruple thread with a 1/3-inch lead and a 1/12-inch pitch can be cut in several ways. Finding the easiest method presents a problem



Scale diagram that correlates quadruple thread and lathe lead-screw for indexing of the tool by the threading indicator.

that has an interesting solution when the lathe used has a lead-screw with four threads per inch. The method does not involve any repositioning of the lead-screw gears, the work, or the com-

pound rest.

As an aid to visualizing the conditions of the problem, two parallel lines of any convenient length, as shown in view X of the accompanying illustration, were drawn on a piece of paper. Each line represents 1 inch of thread. The top scale symbolizes the quadruple thread and is divided into twelve equal parts. Every one-pitch division is given a number, one to four, according to the particular start it indicates. The bottom line, representing the lathe lead-screw, is divided into four equal parts, I to IV. It is important to note that each of the four starts has one position on the multiple-thread scale that lies opposite a one-pitch division on the lead-screw scale. Under these conditions, the threading indicator may be used for indexing the tool when cutting a multiple thread.

One division on the threading indicator dial also equals 1 inch of lead-screw travel. On this particular lathe, the half-nut can be engaged at each quarter-division. Thus, if a division on the threading dial, shown in view Y, is subdivided in the same manner as the bottom or lead-screw scale, the quadruple thread can be cut by engaging the half-nut progressively at each of these quarter-divisions. Number 1 start will be cut at subdivision I, but number 2 start will be cut at subdivision IV. This is indicated by the two scales. Multiple threads with other pitch and lead combinations may also be cut by this

method.

Improvised Method for Grinding Peripheral Clearance on Inserts

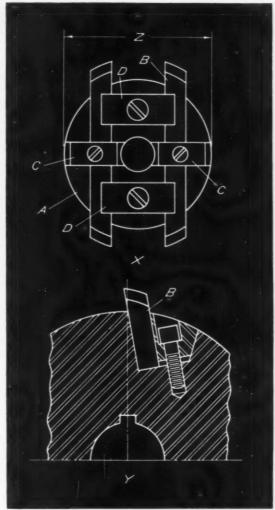
By J. RANDOLPH LUCAS, Richmond, Va.

Grinding peripheral clearance on inserts for milling cutters can be easily done, even though proper tool-grinding equipment is not immediately accessible. This is possible by using the fixture illustrated at X.

The fixture is designed to accommodate all the inserts from a four-tooth cutter simultaneously. It will not only provide a satisfactory peripheral clearance, but will also keep the length of the

cutters equal.

Circular plate A, which serves as the fixture body, has a diameter Z that is approximately onehalf that of the milling cutter shown at Y. The plate is bored to receive a tapered arbor of suitable size. Inserts B are placed in two parallel slots, machined in the face of plate A. Another



Fixture permits grinding of peripheral clearance on milling-cutter inserts (B). All inserts will have the same length after grinding.

slot, which passes across the center of the plate at right angles to the cutter slots, accommodates two stops C, against which the square ends of the cutter inserts are placed. Straps D are used to clamp the cutters in place. Because of the smaller diameter of the fixture, the inserts have sufficient peripheral clearance when assembled in the larger cutter body.

"Torture Chamber" Tests Aircraft

To meet rigid requirements, new military aircraft are tested in a huge "refrigerator-oven" hangar. In this hangar, the airplanes are subjected to temperatures ranging from —65 degrees to 165 degrees F.

Improvements in Hydraulics Discussed at Fabricating Machinery Conference

Improvement in hydraulic products, system designs, and maintenance methods was the objective of the recently held Second Fabricating Machinery Hydraulic Conference. Sponsored by Vickers Incorporated, Detroit, Mich., the conference consisted of audience participation in discussions and free exchange of ideas and experiences among about 140 men. Representatives of manufacturers and users of hydraulic presses, and welding, die-casting, and plastic-molding machinery; hydraulic accessory producers; fluid suppliers; and Vickers engineering and service personnel were in attendance.

Co-moderators for the conference were J. R. Hemeon, hydraulic equipment engineer at the Ternstedt Division of General Motors Corporation, Trenton, N. J.; and O. J. Maha, vice-president, Hannifin Corporation, Des Plaines, Ill. After a welcoming address by M. Hayden, general manager, Machinery Hydraulics Division of Vickers, a film entitled "Vickers Hydraulics, a Universal Tool" was shown. This color-sound film illustrates hydraulic applications in machine tools, fabricating machinery, automobiles, aircraft, and materials-handling units.

"Machinery Development, Pacemaker of Plastics Progress" was the title of the keynote address delivered by R. T. Cruse, executive vice-president, the Society of the Plastics Industry, Inc.

Mr. Cruse emphasized the importance of hydraulics in the plastic industry and cited the increasing use of plastics for tools, dies, fixtures, piping, packaging, radios, telephones, and housing.

A technical paper entitled "Hydraulic Controls for Flash Welders" was presented by H. Hansen, chief mechanical engineer of the Taylor-Winfield Corporation, Warren, Ohio. Mr. Hansen explained why hydraulic controls were used on his company's machines and elucidated the principles of operation. Essentially, the control of the moving platen during the flashing cycle depends on the use of a spool type follow valve. This servo valve meters hydraulic fluid to the cylinder which actuates the platen.

In that portion of the conference agenda devoted to hydraulic circuit and system problems, it was pointed out that pump cavitation may be caused by too low a pressure, the fluid used, or a restricted inlet. Pressure can be increased by using an overhead reservoir or supercharging. In discussing methods for accurately dividing the flow of hydraulic fluid in the 25- to 75-gallon-perminute range, the coupling of the drive-shafts of two hydraulic motors together was recommended as more efficient than valving with venturis. For three or more cylinders, gear-motor type flow dividers are available. Also, multiple pumps driven from a single electric motor can be used—



Co-moderators at the Vickerssponsored Second Fabricating Machinery Hydraulic Conference. O. J. Maha (left) vicepresident of the Hannifin Corporation, Des Plaines, Ill., and J. R. Hemeon (right) hydraulic
equipment engineer at the
Ternstedt Division of General
Motors Corporation, Trenton,
New Jersey.

selecting as many pumps as may be required.

A question about the use of working pressures beyond 3000 psi stimulated comments from several participants. One company is using 4500 psi at 100 gallons per minute for forging and piercing. Another firm is using 5000 psi at 65 gallons per minute, and 10,000 psi at 5 gallons per minute. Vickers personnel added that they propose to offer equipment for 5000 psi at 100 gallons per minute. In reply to criticism about the slower speed of hydraulic presses, one press manufacturer stated that his company produces a 300-ton, double-action, hydraulic press operating at twenty-two strokes per minute for a draw of 2 to 3 inches. Another company builds 800- to 1200-ton, single- and double-action, hydraulic presses operating at eighteen to twenty strokes per minute for a 13-inch draw. One user commented that his company had a 4-ton, hydraulic press operating at 800 strokes per minute through a 3/8-inch stroke.

In another technical paper presented at the conference, John Lasater, plant engineer at the Soil Pipe Division of Combustion Engineering, Inc., Chattanooga, Tenn., described the application of hydraulics to a high-production foundry. The elapsed time from molten metal to finished product (cast-iron soil pipe and fittings), painted and ready for shipping, is only about thirty-five minutes in this automatic foundry. Pipes are cast two at a time in sand-lined molds with centrifu-

gal machines.

Carl Blanchard, chief engineer of Sheridan-Gray, Inc., Torrance, Calif., read a paper entitled "Hydraulics in World's Largest Stretch-Forming Machine." He described a machine for producing airfoil contours at the dihedral point in aluminum wing panels 50 feet long, 1/4 inch thick, and approximately 10 feet wide at the wing root. The edges of the sheet are gripped and pulled while

a die is forced into the sheet to cause the material to yield and take on the desired contour. Four tension cylinders, each capable of exerting a 150-ton pull, are provided on both sides of the sheet. A single, 456-ton cylinder is mounted vertically in the center of the machine to raise the die table into the sheet, and four 600-ton cylinders are mounted in a four-post, vertical arrangement to attach the clamping head to the die table.

In that portion of the conference devoted to pump and valve design, the advantages and disadvantages of central hydraulic systems were examined. Such systems are common in the molding press field, and interest is being revived in their use for die-casting machines, transfer lines, and welding units. One company representative stated they are using three 150-hp, motor-driven pumps for a central system having a capacity of 1200 gallons per minute to operate four-teen die-casting machines. Central systems offer considerable savings for certain applications, but they do not lend themselves readily to changes in plant layout.

Proper cleaning of the hydraulic system, the use of premium oils, adherence to JIC standards, and good maintenance methods were recommended to improve oil life. Also, operation at lower temperatures and the elimination of contamination will reduce the oxidation of hydraulic oils. In the discussion on fire-resistant fluids, it was stated that there are several satisfactory paints available for coating tanks to be used with such fluids. However, one company recommended using unpainted stainless-steel tanks.

In analyzing seals and packings, it was brought out that butyl rubber packings are generally satisfactory for use with most synthetic fluids. Also, some elastometers, as well as polysulphide impregnated leather, show promise for seals and packings compatible with common fluids.

2,000,000-Volt X-Ray Machine to Test Advanced Weapons

The quality of guided missiles, atomic-powered naval ships, and submarines will be closely checked by a new 2,000,000-volt X-ray installation at the U. S. Naval Magazine, Port Chicago, Concord, Calif. The installation will make possible non-destructive testing of vital defense materials and structures.

Castings will be evaluated with the 2,000,000-volt unit before being sent to shipyards that build missiles or nuclear-powered vessels. Services of the X-ray plant will be extended to commercial firms holding government contracts, as well as

to other agencies of the Department of Defense.

The unit, built by General Electric's X-Ray Department in Milwaukee, is housed in a newly erected concrete building that is large enough to permit entry of an entire railroad car or large truck. The machine packs enough power to radiograph a complete diesel locomotive. Closed-circuit television facilities will permit remote observation of internal moving parts so that large, complex operating components can be examined without resorting to costly or destructive disassembly.

59 Engineering Students Win Machine Design Awards

WILLIAM I. O'DONNELL

named by their respective engineering colleges as the recipients of Machinery's Achievement sign. In two instances awards were given to the engineering colleges participated as against fortytwo leading machine design students in their re- two in 1956.

The following 1957 graduates have been spective graduating classes because of the closeness of their standing.

This is the second year that MACHINERY has Award for outstanding excellence in machine depresented these achievement awards. Fifty-seven

Carnegie Institute of Technology Case Institute City College Colorado School of Mines Colorado State University Columbia University Cooper Union

Cornell University Dartmouth College Drexel Institute Georgia Institute of Technology Illinois Institute of Technology Kansas State University Lehigh University Manhattan College Massachusetts Institute of Technology Newark College New York University Northeastern University Northwestern University Ohio State University Pennsylvania State University Polytechnic Institute of Brooklyn Pratt Institute Princeton University Purdue University Rensselaer Polytechnic Institute Rose Polytechnic Institute Stanford University Stevens Institute of Technology Swarthmore College Syracuse University **Tufts University** Union College University of Alabama University of Arizona University of California University of Connecticut University of Idaho University of Illinois University of Kansas University of Maine University of Minnesota University of Nebraska University of New Hampshire University of Notre Dame University of Pittsburgh University of Southern California University of Texas University of Washington University of Wisconsin Villanova University Virginia Polytechnic Institute

Worcester Polytechnic Institute Yale University

Wayne University

Wentworth Institute

Ross A. HACKEL RICHARD A. VAN VALKENBURGH ARTHUR R. BRIGGS ROBERT C. LEHMAN DAVID I. BENNETT FRED BERG WALTER SKRABAL DONALD D. MALCOLM LAWRENCE FURRER OSCAR A. BUCHMANN CLINTON M. HUNTER, JR. ALLIE M. BAKER DONALD D. KNUDSEN ELDEN KUNKLE IOHN WALKER GEORGE H. TICHENOR ORIN A. SHARP, IR. J. ERNEST WILKINS, JR. RICHARD A. KOFFINKE RICHARD A. GAGGIOLI EUGENE LI CHUN YANG RONALD K. EISENHART IEROME OSTROFF RICHARD A. TANZILLI W. DENNY FREESTON, JR. HOWARD E. TATMAN JAMES B. ROBERTS RICHARD E. HIRST KENNETH H. EBERSTEN EDWARD J. SZCZECH ROBERT W. ELLIS EMERY P. GASPAREK WILLIAM WARREN A. H. WILLIAMSON, JR. J. J. HICKS ROBERT W. BUSHROE NORMAN D. MORGAN RONALD G. SCHLEGEL JASPER ROSS AVERY DUANE TONELLI DONALD K. HAGAR WILLIAM T. HUTCHINS DONALD W. MUNSON ROLAND G. STRUSS CONRAD R. TURMELLE WILLIAM L. HOWARD EDWARD I. McGOWEN MYRON WEINER CAREY E. MURPHEY DUANE ROODZANT JEROME O. JUST FREDERIC A. COSTELLO JERRY A. WILKERSON RICHARD A. SCHAPERY ROBERT V. BROPHY

JAMES R. STEWART

JOSEPH J. WEBER

RONALD B. WEST

Pittsburgh, Pa. North Olmsted, Ohio New York City Golden, Colo. Fort Collins, Colo. Rochester, N. Y. New York City New York City Pittsburgh, Pa. Chatham, N. J. Philadelphia, Pa. Greenville, S. C. Chicago, Ill. Manhattan, Kan. Hellertown, Pa. New York City Sterling, Kan. Cranford, N. J. White Plains, N. Y. Islington, Mass. Highwood, Ill. Columbus, Ohio Topton, Pa. New York City New York City Bernardsville, N. J. New Haven, Ind. Troy, N. Y. Riverside, Ill. Jersey City, N. J. Hawthorne, N. J. Highland Park, N. J. Endicott, N. Y. Acton, Mass. Delmar, N. Y Tuscaloosa, Ala. Tucson, Ariz. Berkeley, Calif. Shelton, Conn. Orofino, Idaho Champaign, Ill. Lawrence, Kan. Painted Post, N. Y. Minneapolis, Minn. Lincoln, Neb. Somersworth, N. H. Alton, Ill. Pittsburgh, Pa. Los Angeles, Calif. Tyler, Tex. Oak Harbor, Wash. Madison, Wis. Havertown, Pa. Richmond, Va. Detroit, Mich. North Easton, Mass. Salem, Mass. Worcester, Mass.

New Haven, Conn.

Gear Manufacturers Hold Forty-First Annual Meeting

TWO thousand years of technical progress within one lifetime in our present era, if progress is measured by the standards of any previous generation in history, was the theme developed by J. Lewis Powell of the Department of Defense at the Forty-First Annual Meeting of the American Gear Manufacturers Association. The meeting was held at The Homestead, Hot Springs, Va., June 3 to 5, inclusive.

Mr. Powell's talk stressed the "Collapse of Time" as the principal ingredient in man's technological progress. He illustrated this with a graphic blackboard presentation of the Curve of Progress. It showed

how in 1830 "Man Broke the Oat Barrier" freeing himself from the limitations of the muscle-power of horses. The curve showed man's continued painstaking progress from 1830 until 1945. Whereas from 1945 until now, progress was by leaps and bounds—an onrushing avalanche. Where it had taken man over a century to go from thirty miles an hour to 470 in 1945, it didn't take ten years to go from 470 to more than 1500 miles per hour.



George H. Acker, recipient of the "Edward P. Connell Award"

Mr. Powell stressed how, in 1945, we revolutionized our thinking. We made "Progress a Product" that could be deliberately achieved by the application of mobilized brainpower. In succession, he contrasted progress in speed, explosives, and the range of missiles against the blackboard graph. In each instance, the graph spectacularly illustrated that the avalanche of technology had created more progress in the last twenty vears than in the previous 2000 years.

Mr. Powell pointed out that this avalanche of technological progress had also created an avalanche of obsolescence.

He stressed that national security could not rest as firmly as it once did on stockpiled munitions and weapons, since today's electronic wonders would be obsolete tomorrow. Mr. Powell concluded by stating that a well-informed militaryindustry team is essential to national defense.

Two outstanding technical papers were a feature of the meeting. One of them "Precise Formulas for Over-Pin Measurements of Helical Forms" was prepared by Edward C. Varnum, Head of







Newly elected officers of the American Gear Manufacturers Association (from left to right): LeRoy R.

Brooks, president; E. F. Borisch, vice-president; and John L. Buehler, treasurer.

Operations Research, and Stuart J. Johnson, chief engineer, Small Tool Division, Barber-Colman Co., Rockford, Ill.

Professor Earle Buckingham, technical director of Gear Systems, Inc., Boston, Mass., and T. W. Kiralla, president of the same concern, presented a comprehensive treatise on the design of gears for extreme conditions of speed, load, minimum weight, high ambient temperatures, reliable operation for a short length of life, and so on.

An address entitled "Management Development" was given by H. M. Hopkins, vice-president, Tool Steel Gear & Pinion Co., Cincinnati, Ohio. An address was also made by the Association's recently appointed legal counsel, George P. Lamb.

The 1957 "Edward P. Connell Award"—given annually to an individual who has made outstanding personal contributions to further the art of gearing—was presented to George H. Acker, president, Cleveland Worm & Gear Co., Cleveland, Ohio. Mr. Acker has spent over thirty years in the design and manufacture of cylindrical wormgears and reducers.

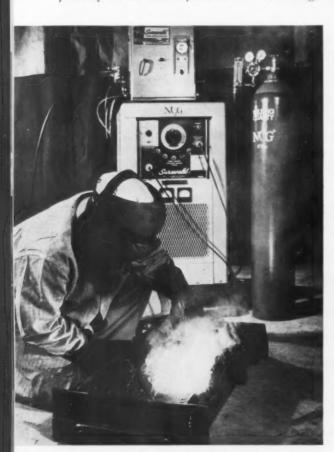
The following officers were elected for the coming year: President, LeRoy R. Brooks, president, Tool Steel Gear & Pinion Co., Cincinnati, Ohio; Vice-President, E. F. Borisch, executive vice-president, Milwaukee Gear Co., Milwaukee, Wis.; and Treasurer, John L. Buehler, president, Indiana Gear Works, Inc., Indianapolis, Ind. An exexecutive committee of six members was elected.

"Dual Shield" Welding

A new shielded-arc welding process permits the operator to see exactly where he is welding. Involved are a flux-core spool electrode and a carbon dioxide atmosphere. Called "Dual Shield," the process has been in the making for over ten years by the National Cylinder Gas Co., Chicago. Any type of mild steel can be welded at high rates of metal deposit and travel speed, and with unusually deep penetration. For the first time, it is claimed, the flux is built in the electrode, forming its core. The flux contains an ionizer to stabilize the electric arc; a deoxidizer which permits welding mill-run steel without cleaning it first; and a slag-forming agent. The inexpensive carbon dioxide excludes contaminating air and also introduces a measured portion of oxygen into the weld pool where it combines with additives in the flux to clean the metal.

The result is an arc at least 1000 degrees hotter than the average 9000-degree welding arc. A single pass with a welding gun can weld the full thickness of 1/2-inch steel plate. Welds are stronger because depth of penetration is 40 per cent greater than can be obtained by manual welding with stick electrodes, NCG contends. One shop using the process now allots six minutes to a Dual Shield welding job that formerly took forty-six minutes to perform manually with a stick electrode.

In the training of welders, the process is said to provide savings in time and cost. In a single day, a novice can be taught to do welding of a quality comparable to that of a man who has been instructed for a month in manual welding; in fact, it is possible to do a good semi-automatic welding job after a few minutes of over-the-shoulder observation, a brief explanation, and a few practice passes with the gun.



"Dual Shield" arc welding, with a flux-core electrode in a carbon dioxide atmosphere



Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

Uncover the Hidden Cost of Records

A NYONE aware of the upward spiral of sales costs admits that we are in for a season of soul-searching economy. One way to save is to simplify records and paper work after uncovering their hidden costs.

The miraculous equipment for preparing an endless variety of statistical information is certainly fascinating. Thus, many of us become so enchanted with what machines can do to grind out data that we freely accept additional information confident it will be useful. Once automatic office equipment is installed, there is a wave of enthusiasm to employ its various skills.

The cost-tag for producing some metal part that the accountant hands to shop management is readily put to use. But when the accountant passes out commercial statistics data, expense has barely begun. Costs subsequent to preparation remind us of the floating iceberg which is mostly hidden. Here is a spot observation of human behavior which may show how easily we accept statistical data without regard to hidden costs:

Entering a sales manager's office, a bright accountant was discussing his facilities to furnish records. We overheard him say: "Here are several additional sets of figures we can give you at practically no extra cost. They will round out a really complete statistical picture—a work of art, complete with detail . . ."

"Well, better include them, guess these days you can't have too much information."

When the accountant left, the sales manager exclaimed: "We will have the most complete set of monthly sales records of any manufacturer from Bar Harbor to L.A."

Six months later, the same sales manager was bewailing the pressures of paper work and shortage of time. Pointing to a pile on his desk, he complained: "Am way behind . . . have all that to go over." Batches of pink paper (a color assigned to accounting reports) betrayed numerous sales records—works of art—that were also circulated to other officials.

The chief cost of paper work is not in its preparation. The National Records Management Council figures it costs \$1.50 to produce just one letter, or \$6200 for the contents of a four-drawer file. But the cost of producing a statistical report usually exceeds that of a letter, and the statistical report is a glutton for executives' time and overhead.

The very small, independent local company ordinarily suffers from lack of sales records. The tendency now for the large corporation—especially the manufacturer of engineered products—is to multiply records, retain most of them too long, and fail to appraise hidden costs.

Extensive statistical records not only consume an executive's energy at a growing rate, worse than that, they keep him from concentrating on more important tasks.

These pointers may help:

1. Though stepping up sales volume to increase profits is loaded with drama, don't forget that savings in paper work and records may outweigh the profit possibilities on additional sales.

2. Establish the principle that sales records have no end in themselves. They are only useful if they lead to profit-making sales.

3. Find out what associates high and low actually do with records relating to sales—not what they say they do with them. The two frequently differ.

4. Study how to save by simplifying records in variety, form, and arrangement, instead of allowing them to get more complex and confusing.

5. Arrange sales reports in relation to items of importance. It is not a question of what people fancy, but what is essential for efficient performance and planning.

To reduce cost of producing statistics is gratifying. The increased hidden costs of using these are alarming.

Let's not get caught, like so many fine old ladies, with an attic full of treasures useless to others and costly to cart away. On the other hand, let us not get caught without essential facts, accurate and well arranged, on which to base the conduct of business.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts and

Elmes Hydraulic Press for Powdered Metal Forming

A hydraulic press of improved angle type design for powdered metal forming has been developed recently by the Elmes Engineering Division, American Steel Foundries, Cincinnati, Ohio. The capacity of the main ram of this press is 1000 tons and that of the side ram, 750 tons. Extra-heavy and rigid all-steel box type construction is employed to minimize deflection. Independent hand-lever control is provided for each ram, with a mechanical interlock preventing movement of the main

ram until a predetermined tonnage is reached on the side ram.

Manually operated, remote control valves permit variation of the tonnage applied to either ram. The die area is faced with hardened-steel wear plates which are reversible. The working area is readily accessible from either the front or rear of the press. A proportioning type of control on both rams facilitates setting up the dies. The interlocked control is removed during the setting-up operation and is locked in place

when the machine is running, to prevent any possible damage to the dies due to malfunctioning. Both main and side rams have rapid approach speeds with slower speeds for pressing and a rapid return speed.

This press is available in a variety of die space and tonnage capacities to meet the user's individual requirements. A third, or bottom, pressing cylinder can be provided as optional equipment.

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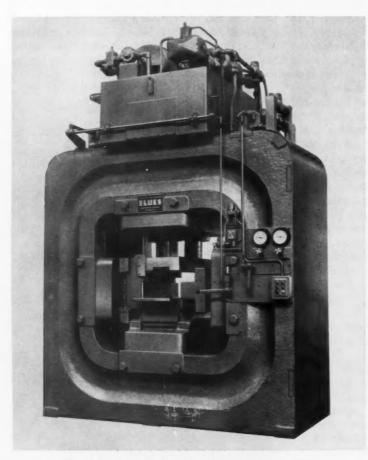
Kit for Converting Aircomatic Gun for Spot-Welding

Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City, has announced availability of an "Aircomatic Spot Kit" that converts standard Model 21 manual Aircomatic gasshielded metal-arc welding guns for arc spot-welding. The kit consists of an auxiliary control panel, an outer barrel, and a flat nozzle. Spot-welding of lap joints or tack welds in a butt, lap, or fillet joint can be made on mild steels.

Welds are produced by placing the gun against the work and operating the trigger. The heat of the gas-shielded arc between the work and the automatically fed filler wire produces a circular weld. Required amount of filler wire is melted off, being added to the weld for reinforcement. All necessary operations—wire feed, weld time, pre-weld gas purge—are automatically controlled.

Standard Model 21 Aircomatic guns are rated at 350 amperes continuous duty, direct-current, reverse polarity for regular Aircomatic welding. For Aircomatic spot-welding only, the gun can be used at up to 500 amperes directcurrent, reverse polarity.

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Hydraulic press developed by the Elmes Engineering Division, American Steel Foundries, for powdered metal forming

SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

Multiple-Spindle Drilling and Tapping Machine

The National Automatic Tool Co., Inc., Richmond, Ind., has announced a new standard arrangement of its H-6 multiple-spindle drilling and tapping machine. This machine is now available with pre-set selective cycle control and a straight-line indexing slide. Thus equipped, it makes automated drilling and tapping practical—even for small-lot production of parts usually handled by gang drills.

The operator simply unloads the finished part, loads a new one, and depresses the starting switch. The machine then goes through all operations and returns to the loading position. Over 100 combinations of operations—including drilling, tapping, step-drilling, chamfering, countersinking, counterboring, and spot-facing—are

possible by merely setting selector

Table movement in the drilling cycle consists of rapid traverse up, feed up, and rapid traverse down; tapping cycle—rapid traverse up, feed up, feed down, and rapid traverse down; chamfer cycle (including countersinking, spot-facing, etc.)—rapid traverse up, feed up, dwell and rapid traverse down. The table can also be arranged to travel a further distance for drilling than is required for performing the chamfering operations.

Table feeds are controlled by two dials, one for drilling and the other for tapping. Taps of different leads can be used by the vertical float arrangement built into the spindles. The hydraulically actuated indexing slide is electrically controlled by selector switches and is available with two, three, four, or five positions. Various types of work-holding fixtures can also be mounted on the machine slide.

The basic machine consists of a multiple-spindle geared head and a hydraulic feed table. Spindles are driven through universal joints. They can be arranged with adjustable arms for positioning or can be fixed in the required layout by a slip spindle plate, fastened to the head of the machine. Up to twenty-four spindles can be used, depending primarily upon horsepower consumed. A 3-hp motor is standard for the drive on the regular H-6 machine; and a 5hp motor is specified as standard on the heavy-duty machine.

Circle Item 103 on postcard, page 259

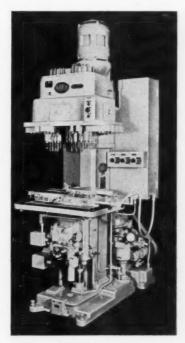


Fig. 1. Natco H-6 multi-spindle drilling and tapping machine available with selective cycle control

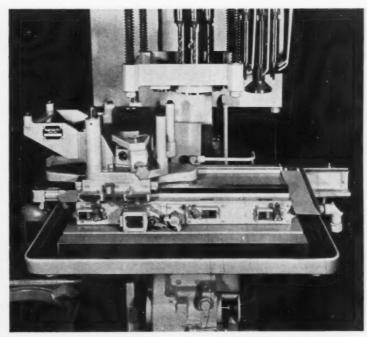
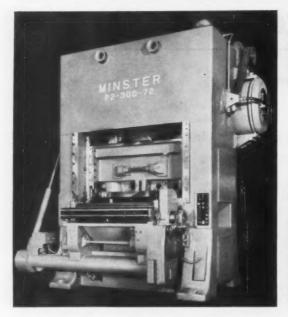
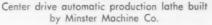


Fig. 2. Typical application of machine shown in Fig. 1 with first position used for unloading and loading. Part is drilled in second position and tapped in the third position.







Small-size turret lathe distributed nationally by Cem-Way Sales Co.

Minster Center Drive Automatic Production Press

A 300-ton Piece-Maker P2-300 two-point, straight-side press for automatic progressive production is announced by the Minster Machine Co., Minster, Ohio. This is a single-geared center drive type press, capable of operating in the speed range of 75 to 150 strokes per minute with a standard 3-inch stroke. It is available in bed widths of 66, 72, or 84 inches right to left and 48 inches front to back. The slide measures 34 inches front to back.

The steel herringbone main drive gear is mounted in the center of the two-point, full eccentric crankshaft and is counterbalanced to equalize the weight of the crank eccentrics. This center drive construction reduces torsion, equalizes power transmitted to the slide connections, and makes the use of higher speeds practical.

Standard single- or double-roll feeds are available for feeding from either direction or front to back. The press shown has a single-roll front-to-back feed driven from the crankshaft through spiral miter gears. It is designed to provide maximum stability for continuous heavy blanking operations on materials such as high-carbon steel. Precise slide

to bed parallelism even under offcenter loading is maintained by the eight extra-long bronze-lined ways, cast gibs, and rigid box type slide construction..

The P2-300 press has a Minster patented combination air-friction clutch and brake unit outboard-mounted on the drive shaft within the press flywheel. A recirculating oil lubrication system provides a continuous oil film to all bearing surfaces. The operator's station, drive, and clutch controls are safely and conveniently located on the press upright. The centralized press control cabinet is mounted off the press.

Circle Item 104 on postcard, page 259

Cem-Way Turret Lathe

A No. 00 turret lathe which relieves larger equipment, eliminates re-setup time, and allows final operations to be performed by unskilled personnel, is being distributed by the Cem-Way Sales Co., Bristol, Wis. This lathe—primarily intended for secondary operations—has a single synchronized, cam-actuating lever which locks the work in position ready for centering, cutting-off, spot-facing, drilling, threading, turn-

ing, forming, chamfering, and pinpointing round parts up to 5/8 inch in diameter. It will hold concentricity within limits of 0.0003 inch

This lathe is small enough to facilitate its use as a portable machine and is designed especially for continuous production of small parts. Having greater sensitivity and faster speeds than larger machines, it will save time and effort on work within its capacity. It can be equipped with a one- or twospeed motor to provide three or six spindle speeds. The control switch is always within easy reach, permitting instant starting, stopping, or reversing of the spindle. The lathe is constructed for Cem-Way Sales by the Clark Engineering & Mfg. Co., Racine, Wis.

Circle Item 105 on postcard, page 259

"Skew Loader" Developed for Automated Heat-Treating Line

A "Skew Loader" that enables an operator to load 4200 faceoriented gears per hour onto a gear carrier has been developed by the Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich. Although designed expressly for high-volume heat-treating of gears, the "Skew Loader" is applicable to many other centerbored parts and production methods.

In operation, the gears enter the "Skew Loader" through a gravity expandable track and are stopped by an escapement mechanism. From the escapement, gears are fed one at a time into a V-track and are pushed forward by the plunger of an air cylinder actuated by a proximity switch. The air cylinder, returning to neutral, triggers a limit-switch-controlled solenoid which releases another gear. This action takes place in split seconds-an average skew load of about fourteen gears is readied in less than five seconds.

When a full load is positioned, the operator merely inserts the skew (or rod) through the centerbored holes and lifts the load onto a gear carrier. The operator's action is almost continuous. Larger or smaller gears can be handled simply by changing the retaining fixtures. The unit is push-button-controlled and can be run manually as well as automatically. The loader requires a floor space only 36 by 36 inches.

Circle Item 106 on postcard, page 259

South Bend Vertical-Spindle Precision Milling Machine

vertical-spindle precision milling machine with improved design features is being built by South Bend Lathe Works, South Bend, Ind. The head of this machine swivels a full 360 degrees on the flanged end of the overarm for milling, drilling, or boring at any angle. A key with tapered gib prevents the over-arm from turning in the column bearing and permits moving the head transversely without affecting its angular setting. Vernier graduations reading in minutes and worm-gear adjustment facilitate setting of head angle with extreme precision. The over-arm is 4 1/2 inches in diameter, has rack-and-pinion cross movement of 15 inches, and can be locked rigidly at any point.

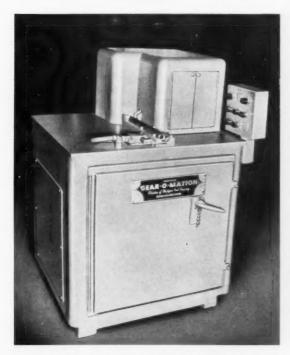
The milling machine base has been enlarged and strengthened. Table feed-screws are equipped with large handwheels. Dual controls permit operating table from either end. The micrometer collars on the feed-screws have a frosted finish with black graduations which serve to eliminate eyestrain.

The table is 9 inches wide and is available in 32- and 42-inch lengths, providing 20- or 30-inch longitudinal travel respectively. Vertical adjustment of table is 18 inches. Maximum distance from table to spindle is 20 inches and from spindle to column, 20 inches. Adjustable stops regulate the length of table feed. Measuring trays with dial indicators are available for precision positioning of the table with both the crossfeed and longitudinal feed-screws.

The spindle has a No. 30 milling machine taper with 3/4-inch collet capacity. It has a 4-inch vertical travel with lever for rapid movement and handwheel for slow feed.

A precision micrometer depth stop and positive quill lock are provided. Compound V-belt and timing belt drive transmits power to the spindle. This machine is provided with eight spindle speeds that range from 90 to 2500 rpm with a 3/4-hp motor having a speed of 1200 rpm, or 135 to 3750 rpm with 1-hp motor operating at a speed of 1800 rpm.

Circle Item 107 on postcard, page 259



Gear-O-Mation "Skew Loader" for automated production line developed by Michigan Tool Co.



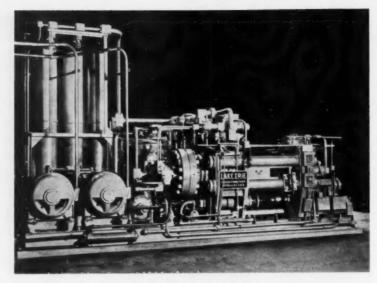
Vertical-spindle precision milling machine built by South Bend Lathe Works

Cold-Extrusion Press

Several cold-extrusion presses developed and built by the Lake Erie Machinery Corporation, Buffalo, N. Y., have extruded automobile torsion bar anchor housings from 1035 steel at a rate of 525 per hour, holding concentricity to 0.010-inch total indicator reading.

The presses are rated at 440tons extrusion and 44-tons ejection pressures. The high production rate is obtained by automatic cycling in conjunction with a special five-station patented dial feed: the dial has two movements -axial and rotary. A hydraulic cylinder moves the dial axially to clear the fixed tools during indexing. Each time a billet is extruded. a new one is fed into a dial station and an extruded billet is stripped from the die. The versatility of the press is such that production possibilities are limited only by the die-holder size, configuration of the part, and tonnage capacity of the press.

Approximately 24 feet long, the press has a 51-inch daylight capa-



Lake Erie cold-extrusion press

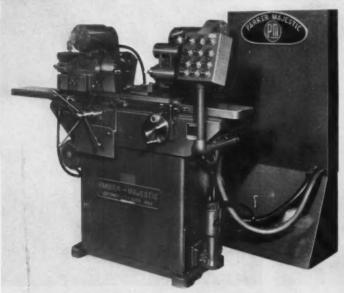
city and an 18-inch main ram stroke, Approach speed is 1200 inches per minute, and extrusion speed, 500 inches per minute at 2550 psi.

Circle Item 108 on postcard, page 259

Semi-Automatic Internal Contour Grinder

The Parker-Majestic, Inc., Detroit, Mich., has announced a semi-automatic internal contour grinder which has a cam and cam

follower installed at each end of the work-head. This arrangement



Parker-Majestic semi-automatic internal contour grinder

prevents any possible twisting or binding and insures a smooth follower action. The infeed of the grinding wheel is controlled by a cam. When this cam is rotated by means of a ratchet mechanism through 360 degrees, it completes a cycle consisting of rapid infeed for roughing, dwell for wheel dressing, and finally a slow infeed for finishing.

Sizing is accomplished through the use of a micrometer type wheel dresser which, when positioned, insures a high degree of accuracy in the production of duplicate parts. Table movement is energized by any one of three built-in methods: hand feed using the capstan type handwheel; power feed through a gear-driven mechanism electromechanically controlled for the full table travel of 12 inches; and the use of a reciprocator mechanism in which the stroke is adjustable from 0 to 3 inches.

It is a simple matter to change work-head cams to permit grinding many different internal forms. This feature is particularly desirable when relatively short-run production on several parts is demanded. The swing over the table is 10 inches, and the maximum table travel is nominally 12 inches. The machine shown in the illustration weighs approximately 2500 pounds.

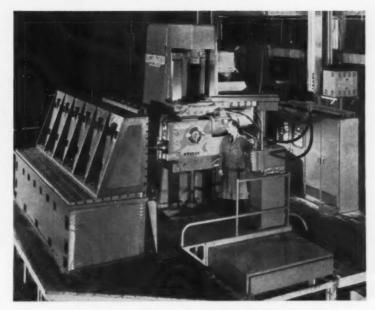
Circle Item 109 on postcard, page 259

Profile-Milling Machine with Numerical Control

A numerically controlled profile-milling machine built by the Kearney & Trecker Corporation, Milwaukee, Wis., has recently been tested by the Air Materiel Command at the Wright-Patterson Air Force Base in Ohio. This is the first of twenty-two machines of this type to be produced by Kearney & Trecker under the Air Force machine tool modernization program.

The new profile machine shown can be used for milling high-tensile steel as well as aluminum and exceeds the National Aircraft Standards' production requirements in both feed rate and revolution per minute ranges. The feed rates are from 1/50 inch to 100 inches per minute. The spindle is powered by a 20-hp motor and operates within a speed range of 36 to 1800 rpm.

The machine operates from digital information punched on a plastic tape and translated into code by an interpolator. Movements in three directions are obtained by signals generated from the coded information that defines the desired shape of the finished work-piece. High-speed digital computers are used to process the data required by the new method



Kearney & Trecker profile-milling machine controlled by punched tape

of motion control, which was developed and built by the Bendix Aviation Corporation.

The work of these profile millers is not confined to the aircraft industry but can be applied to all metalworking industries including those using high-tensile steels as components.

Circle Item 110 on postcard, page 259

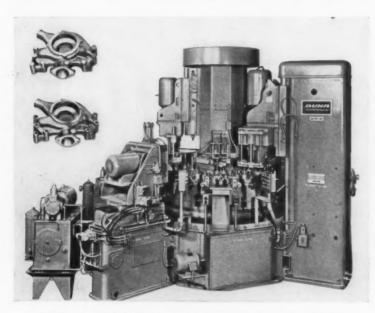
Economatic Built to Process Water-Pump Housing

The Buhr Machine Tool Co., Ann Arbor, Mich., recently built an Economatic for high-speed processing of an automotive part.

Two noteworthy features of this machine are: ease of conversion for machining other parts; and provision for removing the automatic index unit which actuates the table without disturbing any other part of the machine. Other features include: automatic clamping of parts, automatic lubrication of fixtures and all moving parts, steel hardened-andground detachable ways, complete interchangeability of standard and special parts, automatic chip removal, and construction to IIC standards.

This machine was built specifically to perform fifty-five operations on an automotive water-pump housing after the mounting pads have been ground. Processing the pump housing on the Economatic, equipped as shown in the illustration, consists of performing one milling, eighteen drilling, ten reaming, seven chamfering, ten tapping, seven spot-facing and two boring operations.

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Buhr Economatic built for processing automotive water-pump housing

MACHINERY, July, 1957-217



Combination shearing, punching, and coping machine marketed by Joseph T. Ryerson & Son, Inc.

Shearing, Punching, and Coping Machine

Joseph T. Ryerson & Son, Inc., Chicago, Ill., is marketing a combination machine for manufacturers of heating and ventilating equipment, construction companies, maintenance shops, and metal fabricators that require high-speed punching, shearing, and coping equipment. This ma-

chine punches up to and including 13/16-inch diameter holes in 3/8-inch thick steel plate, and up to and including 11/16-inch holes in 1/2-inch plate. It shears up to and including 4- by 4- by 1/4-inch steel angles, 4- by 1/2-

inch flat bars, 1 3/8-inch round bars, 1 1/4-inch square bars, and 3/8-inch thick steel plate. It also performs notching and coping operations. Larger-capacity units of this machine are also available.

Circle Item 112 on postcard, page 259

Hydraulic Forging Manipulator

A German-built forging manipulator in which all movements are performed hydraulically is being distributed in the United States by the Industrial Equipment Division of the Kurt Orban Co., Inc., Greenwich, Conn. One or two pressure pumps driven by electric motors deliver water to an accumulator at a pressure of 1420 psi for operation of the manipulator. From the accumulator, the pressure water is directed to the control center which, in turn, supplies pressure water as required to the various working cylinders. All functions such as traveling, movement of the gripper, and opening and closing of the jaws are obtained solely by the hydraulic system.

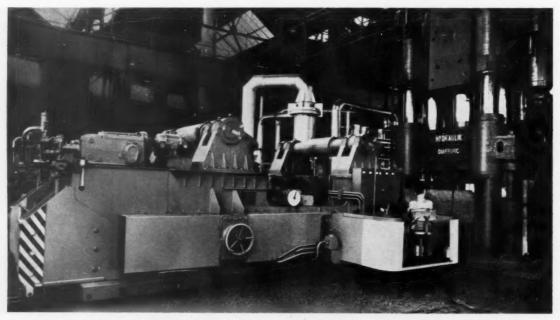
The one or two electric motors required to drive the pumps can be of relatively low power, because the energy for feed power demand is stored and supplied by the hydraulic accumulator. No regulators and clutches are required, and all movements are uniformly variable. An overburdening of the hydraulic system is prevented by a built-in overload protection device. The manipulators are built in standard sizes, ranging from a carrying capacity of 5500 pounds to 220,000 pounds.

Circle Item 113 on postcard, page 259

DoALL Low-Powered Saw

The Doall Co., Des Plaines, Ill., has introduced a Model C-12 power saw for tool and die, maintenance, and similar shops. This saw can be operated by unskilled workers and can be set up quickly and run at high speed. It will handle 12-inch rounds, 12-by-12-inch square stock, and work weighing up to 1500 pounds.

Four speeds are available by means of step pulleys, so that one may be selected to suit the spe-



Hydraulic forging manipulator introduced in this country by the Kurt Orban Co.





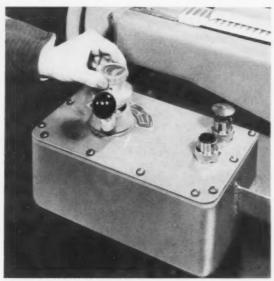


Fig. 2. Valve controls for machine shown in Fig. 1.

cific job. The built-in coolant system and hydraulic band tension control assure long blade life.

The start-stop push-buttons for the electric motor and the control for the hydraulic feed are conveniently grouped together on a panel near the front of the machine, Fig. 2. There is also an automatic hydraulic lock to prevent movement of the cutting head in case the electric power is cut off or in case of power failure. The four-position hydraulic valve, Fig. 2, controls the movement of the sawing head. The valve provides rapid traverse for either up or down direction, stop, and feed. In the feed position, a calibrated control permits an infinitely variable feed rate.

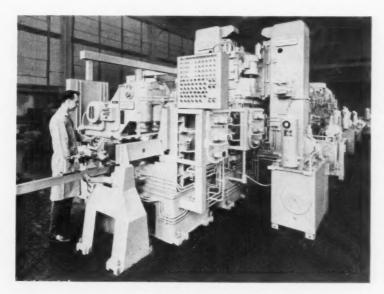
Circle Item 114 on postcard, page 259

Snyder Transfer Machine for Processing Two Different Parts

A segmented, in-line transfer machine built by the Snyder Tool & Engineering Co., Detroit, Mich., mills, drills, chamfers, and taps two different automotive engine exhaust manifolds at a net production rate of 136 manifolds per hour. Built-in sensing devices in the twenty-eight-station, 63-foot long automated machine make it possible for the two different parts to be processed.

The joint faces of the two manifolds are identical and the milling, drilling, and tapping operations are first performed on these areas. Additional clamping support is required for drilling, chamfering, and tapping one of the manifolds. This support is provided at these stations by sensing devices that find the work by detecting a cast surface and causing a hydraulically operated clamp to engage the part.

The next operations on the manifolds are performed after the parts are automatically turned over by a rotating fixture. These subsequent milling, drilling, chamfering, and tapping operations are not common to both parts. Part A is processed through these operations and passes through the balance of the machine with the stations automatically.



Segmented transfer machine for processing two different parts built by the Snyder Tool & Engineering Co.

cally idled by sensing devices that detect one part from another by searching for the cast surface. Part B has idle stations through the first operations and is processed in the last stations on the machine.

Probing stations that check all holes and shut down the machines if any incomplete holes or broken taps are detected are provided in four stations of the machine. The machining units are of the Snyder standard type with hardened and ground ways; seven way type units and eight self-contained units are used. Tapping head spindles have individual lead-screw drives. The machine is hydraulically operated and electrically controlled.

Circle Item 115 on postcard, page 259

Microscope for Toolmakers and Machinists

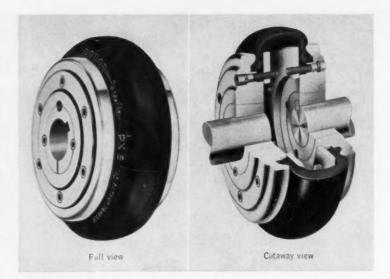
A microscope of improved design for use by machinists and toolmakers in the inspection and measurement of tools, drill jigs, templates, and finished parts has been announced by the Bausch & Lomb Optical Co., Rochester, N. Y. This toolmaker's measuring microscope, is designed to provide the versatility, convenience, sturdiness and accuracy previously available only in higher priced equipment.

Standard magnification is 35X, but different objective and eyepiece combinations may be used to obtain other magnifications.

Circle Item 116 on postcard, page 259



Bausch & Lomb toolmaker's microscope



"Para-flex" flexible coupling introduced by the Dodge Mfg. Corporation

Dodge "Para-flex" Flexible Cushion Coupling

A flexible coupling of entirely new design, called "Para-flex," is announced by the Dodge Mfg. Corporation, Mishawaka, Ind., as the latest addition to its line of power transmission machinery. The ability to handle angular and parallel misalignment, as well as end-float, is only one of many advantages claimed for this coupling. The flexible member also serves to cushion shock loads and diminish torsional vibration.

The heart of the coupling is a tire with synthetic tension members bonded together in rubber. In fact, the new coupling is said to have been made possible by developments in the process of manufacturing automobile and truck tires to carry tremendous loads at high speeds and to withstand terrific shocks. It is claimed that the four-way flexing body of "Para-flex" supersedes the most complex coupling mechanisms, yet it operates with the simplicity and dependability of a modern tire.

In addition to operational advantages, the coupling has features that facilitate installation and maintenance. It is simple and dependable, consisting essentially of the flexible tire clamped between two hubs which are mounted on the shafts to be coupled, as shown in the cut-away view in the illustration. The flexi-

ble member is held between the flanges and clamp rings of the hubs. Both hubs of the coupling are machined to take Taper-Lock bushings that give the equivalent of a shrunk-on fit on the shaft and permit quick and easy application to shafts of different diameters.

A transverse split in the tire permits easy installation and, also, makes replacement possible without moving the driving or driven machine by simply loosening the cap-screws.

The "Para-flex" coupling will take angular misalignment up to 4 degrees, parallel misalignment up to 1/8 inch, and end-float up to 5/16 inch—contingent upon the size of the coupling and the duration of the conditions—or it will take all of these simultaneously. Torsional vibration developed by internal combustion engines is absorbed to a great degree.

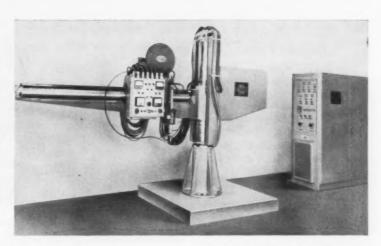
Because there is no metal-tometal contact in the "Para-flex" coupling, it requires no lubrication. The coupling, developed in West Germany, has been adapted to the standards of American industry by the Dodge Mfg. Corporation and will be stocked by its distributors in popular transmission sizes. It is available from factory stock in capacities from 4 hp at 1800 rpm up to 600 hp at 900 rpm.

Circle Item 117 on postcard, page 259

Welding Head Manipulator and Control Console

A welding head manipulator and control console for longitudinal and circumferential welding has been brought out by the Machine Welding Department, Air Reduction Sales Co., Division of Air Reduction Co., Inc., New York City. The unit was engineered by Airco's machine welding department to facilitate universal positioning and accurate variablespeed traversing of the welding head. The manipulator is of allwelded construction and is especially designed for precision welding applications on aircraft jetengine components and similar intricate parts. Both "Heliwelding" (tungsten inert-gas arc welding) and "Aircomatic" (metal inert gas arc welding) automatic heads may be mounted on the manipulator.

The electrical console provides all the necessary controls for complete programming of the welding operation, electronic timers being provided for sequence control. The console includes a welding



Welding head manipulator and control console made by Air Reduction Co.

power source with current slope control, accessories for control of shielding and back-up gases, a self-contained water circulating unit, and other features.

The welding head manipulator and control console can be designed and constructed to suit each production-line application.

Circle Item 118 on postcard, page 259

have a vertical travel of 23 inches, while the 24LA has a vertical travel of 20 inches. The table of the 24LA machine is 50 by 10 1/2 inches and that of the 24MA and 24MLA is 50 by 12 inches.

Circle Item 119 on postcard, page 259

Chicago-Latrobe Extra Long Drills

Extra long drills of high-speed steel with straight shanks in wire gage sizes No. 52 through No. 1, in fractional sizes from 1/16 through 1/2 inch in diameter, and also with taper shanks in sizes from 1/8 inch through 1 1/2 inches in diameter are available from Chicago-Latrobe, Chicago, Ill. Regular sizes have maximum length of 18 inches.

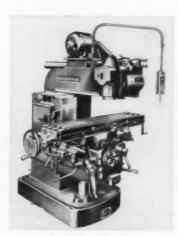
Circle Item 120 on postcard, page 259

Van Norman Milling Machines

Three new models have been added to the ram type milling machines manufactured by the Van Norman Machine Co., Springfield, Mass. All three machines—24LA, Fig. 1; 24MA, Fig. 2; and 24MLA, Fig. 3—feature the exclusive Van Norman adjustable cutter-head which permits horizontal, vertical, and angular milling to be read-

ily performed on one machine.

The 24LA and 24MLA machines have nine spindle speeds, ranging from 50 to 1400 rpm; and the 24MA has twelve spindle speeds, ranging from 40 to 1600 rpm. All these machines have a cross travel of 12 inches and a longitudinal travel of 28 inches. The 24MA and 24MLA machines







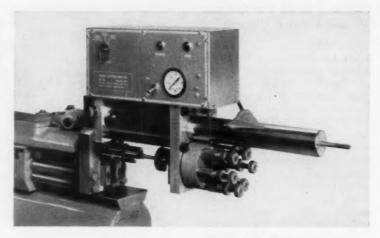
Three milling machines—designated 24LA, 24MA, and 24MLA—made by the Van Norman Machine Co.

Bliss High-Speed Forging Press

The E. W. Bliss Co., Canton, Ohio, has recently redesigned its line of high-speed forging presses. Among the new features is a tonnage limiter which prevents accidental overloading of the press by automatically reducing the air pressure on the clutch as the slide approaches the bottom of the stroke and increasing it on the return stroke.

The brake has also been redesigned: a double rather than a single clam shell brake is now used. This has increased the braking area and, along with the application of a larger cylinder, has served to double the braking effect.

Other features include: air counterbalances instead of the previously used "buffers;" air-actuated wedge type die seat, redesigned flywheel brake; and new



Sandex automatic power feed for turret lathes

gear drive for both the limit switch and lubrication pump, replacing the earlier sprocket drive. All of the forging presses of the company's line are now built with a solid frame.

Circle Item 121 on postcard, page 259

Automatic Power Feed for Turret Lathes

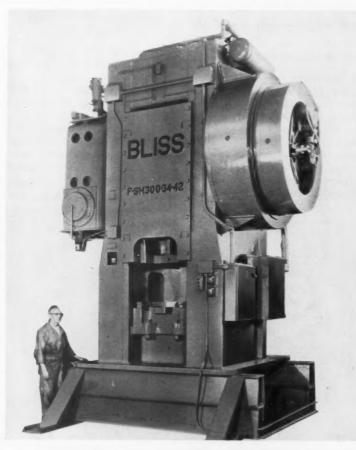
Sandex Automation, Brooklyn, N. Y., is manufacturing a line of automatic power feeds for machine tools. The Model HR-1 turret lathe installation shown in the illustration features a separate feed for each turret position with infinitely variable feed adjustments. It operates on an air pressure of 50 to 100 psi and incorporates a hydraulic cylinder which gives it an extremely precise feed that is easily varied by simply turning a feed-screw for each position. This unit indexes the turret automatically and provides fast approach and return feeds.

Circle Item 122 on postcard, page 259

McCrosky Turret Toolposts with Clamping Type Handle

A novel clamping type handle is a feature of the turret toolposts recently introduced by the Mc-Crosky Tool Corporation, Meadville, Pa. The clamping handle assures positive locking-even when handling interrupted cuts or the fast feeds and speeds of heavyduty production lathes. The action of the handle is fast and simple. Raising the handle from an approximately horizontal position to about a 45-degree angle clamps a locking collar tightly around the center column of the turret with a powerful cam action.

The turret is unlocked simply by lowering and pushing the han-



Redesigned high-speed forging press announced by E. W. Bliss Co.



Turret toolpost introduced by the McCrosky Tool Corporation

dle slightly. This permits the turret to be rotated freely to any of twelve indexing positions to bring the required tool for the next operation into the proper cutting position.

Turrets with this clamping type handle are available in three styles and eleven different sizes for mounting in the T-slot of the compound rest or the bolt circle of the main slide.

Circle Item 123 on postcard, page 259

Large-Capacity Metalworking Press

The Federal Press Co., Elkhart, Ind., has added a Model 55, large-capacity press to its line of metal-working machines. This 56-ton unit is designed with over-size dimensions to accommodate larger dies. It will economically handle lamination, die-casting, trimming, and a wide range of similar operations which would otherwise tie up larger and more expensive equipment.

The standard stroke of the new press is 4 inches, but strokes up to 12 inches are available at extra cost. Standard ram area is 11 1/4 by 24 inches, but provision can be made for ram areas up to 11 1/4 by 36 inches.

A normal press shut height of 12 1/4 inches is standard. A shut height of 21 inches is obtained by means of a frame extension. A throat depth of 15 inches is standard, but a depth of 17 inches is also available.

The regular standard opening through the back is 22 inches, but an opening of 26 inches can be furnished. The bolster plate is 36 by 28 inches. This press is built in either the flywheel or geared type, in mechanical or air clutch models.

Circle Item 124 on postcard, page 259

Hydraulic Motor Drive for Mechanical Type Broaching Machine

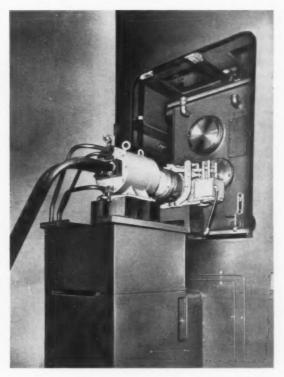
High-speed vertical and horizontal mechanical type broaching machines produced by the Colonial Broach & Machine Co., Detroit, Mich., are now available with hydraulic motor drive for the main driving gear. The hydraulic unit and motor assemblies are said to be economical in initial and installed cost.

Hydraulic motor operation is immediately available on all Colonial mechanically driven broaching machines up to the 10-ton capacity models. Simplicity and smoothness (even of startstop operation) are important features of the machines equipped with the hydraulic motor drives which will be marketed under the name "HydroGear."

Circle Item 125 on postcard, page 259



Federal Model 55, large-capacity metalworking press



Colonial hydraulic motor drive for broaching machine

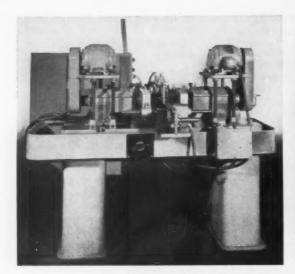


Fig. 1. Special tapping machine built by the Ettco Tool & Machine Co., Inc.

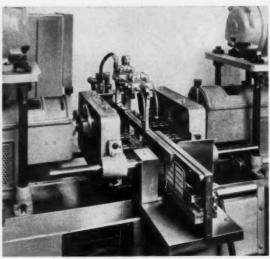


Fig. 2. Close-up of Ettco-Emrick tapping machine shown in Fig. 1

Ettco-Emrick Machine Taps 28,800 Holes per Hour

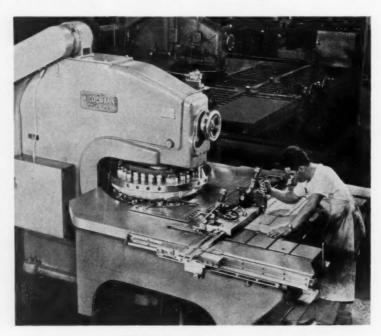
The Ettco Tool & Machine Co., Inc., Brooklyn, N. Y., has built a special machine for tapping 6-32 holes (7/16 inch between centers) in either of two different types of brass terminal inserts set in phenol fiber-forty holes in one part and twenty in the other-at the production rate of 720 completed parts every hour. Standardized "unit-engineered" Ettco-Emrick components were used in building this special two-way, horizontal, automatic lead-screw tapping machine equipped with vacuum mist lubrication and chip disposal system. With this machine either part can be produced at the required production rate. Operating at 100 per cent efficiency, a part is produced at each stroke of the machine. This is equivalent to a production rate of 28,800 holes per hour.

Parts of either type are handloaded vertically into a track (see Fig. 2) and pushed forward into the work position by means of a hand-actuated fixture. When the part is in position, two synchronized horizontal A.T.U. No. 3 lead-screw tapping units are actuated. These units, each of which is set up with a twenty-spindle multiple head, also have pickup rods and a safety device to assure error-proof positioning of the parts—a feature that eliminates spoilage and tap breakage. As each part is progressively fed through the two work-stations, one completely tapped part, free from oil or chips, is automatically ejected into the tote box. Since the parts must be dry, mist-fed lubrication is used.

Circle Item 126 on postcard, page 259

Turret Punch Press with High-Speed Follower Gage

The Wiedemann Machine Co., Philadelphia, Pa., is manufacturing a RA-61 turret punch press designed for economical highspeed piercing of truck parts, heavy electronic chassis, panels, side-plates, and other sheet-metal or plate parts in low to medium production quantities. This 40-ton capacity press, equipped with the



Wiedemann turret punch press

Wiedemann high-speed follower gage (pantograph), eliminates setup and work layout operations. Flat sheet metal or plate up to 33 by 40 inches is pierced in one handling. Work is located to close tolerances and pierced at the rate of thirty or more holes per minute.

The power-operated RA-61 press provides maximum flexibility with respect to the shape and size of punches and dies that can be used. Its rotating turrets house twenty to twenty-eight tools which can be brought into the piercing position in three to five seconds.

Work is secured to the crossslide of the mechanical follower gage. Therefore, it follows the slide accurately in any direction as the operator moves the control stylus from hole to hole in a colorcoded template clamped to the table. When the stylus point enters a small diameter hole in the template, the work is properly positioned, and the press is automatically tripped.

This heavy-duty press, with a throat depth of 33 inches, will punch holes up to 6 inches in diameter in 1/8-inch mild steel or up to 1 1/2 inches in diameter in 3/8 inch mild steel.

Circle Item 127 on postcard, page 259

Single-Geared, Double Crank, Straight-Sided Press

The Cleveland Punch & Shear Works Co., Cleveland, Ohio, has announced a 200-ton singlegeared, double crank, straightsided press. This press is equipped with twin drive and an electrically controlled heavy-duty drum type friction clutch with air brake. The flywheel has an auxiliary air brake to permit quick stopping when the power is suddenly shut off. The press has an 8-inch stroke, 10-inch adjustment of slide, shut height of 30 inches, slide or plunger face 48 by 96 inches, and a bed opening 33 by 81 inches.

Presses in this series are available in capacities of 75, 90, 110, 120, 150, 200, 250, and 350 tons. They can be modified in respect to die space, stroke, adjustment, bed area, etc., thus offering an almost unlimited number of combinations. The variety of sizes and capacities in which the presses are available provides for the handling of material of any thickness from light sheet metal to heavy steel plate. The presses are built in single-geared, doublegeared and flywheel types, and can be used for such operations as punching, forming, stamping, bending, cutting, and light em-

bossing-usually of large or irregular shapes. The twin drive is used exclusively on the larger presses and where work is heavy. Circle Item 128 on postcard, page 259

Escapement Type Universal Spring Coilers

Universal spring-coiling machines with the design based on the escapement principle have been brought out by Sleeper & Hartley, Inc., Worcester, Mass. These machines are specifically designed for accurate, high-speed production of springs. The accuracy and scope of the feed range are outstanding features.

The longer, more accurately measured feeds are made possible by an entirely new holding action which allows more than one revolution of the feed-roll per spring. Feed ranges beyond the standard limitations are accomplished by a feed-cycling arrangement combined with continuous coiling and manual cutter control. Spring production is readily regulated by the variable-speed drive, with dialed speeds and push-button start, stop, and jog control.

Circle Item 129 on postcard, page 259



Cleveland single-geared, double crank press



Sleeper & Hartley universal spring coiling machine



Automatic parts elevating and feeding unit developed by Gear-O-Mation Division, Michigan Tool Co.

Feeding Device Elevates Parts from Hopper

A device for high-speed, automatic elevating, orienting, and feeding of parts to automated production lines or individual machines has been developed by the Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich. This device uses a combination feeding unit to handle parts that roll or slide, such as gears, cylinders, and spiders. Although custommade to suit a specific job, the unit is assembled from standard components.

In operation, parts are conveyor-fed or truck-dumped into the hopper section of the unit. From there, they are scooped onto slanted shelves for elevating and feeding to a distribution system. When elevated, properly positioned parts roll through, while improperly positioned parts are chuted back to the hopper. Before passing into the main distribution system, parts from the elevator are again checked as to orientation by being passed over a narrowed track. If not "in line" they drop off and are returned to the hopper. The unit is driven by an enclosed, 1/2-hp motor and variable-speed transmission unit. Elevator height, capacity, and feeding take-off rate are variable to suit application.

Circle Item 130 on postcard, page 259

Special Double-Acting Thrust Bearing for Gear Reduction Units

The Rollway Bearing Co., Syracuse, N. Y., has brought out a special double-acting thrust bearing (shown at left in illustration) which is designed to withstand extremely heavy thrust loads from either direction. This flat-seat type bearing, with 2-inch bore and 6 3/6-inch outside diameter, consists of center plate, two roller assemblies, two stationary plates, and two rotating inner sleeves. The inner sleeves and center plate are keyed to the pinion shaft to insure position rotation under all conditions.

Machined bronze retainers con-

tain four 1/2-inch diameter rollers in each of sixteen slots. Three rollers are 1/2 inch long; the fourth, 3/8-inch in length, is staggered to equalize distribution of wear. Thrust capacity of DT type bearing is 17,550 pounds at 750 rpm.

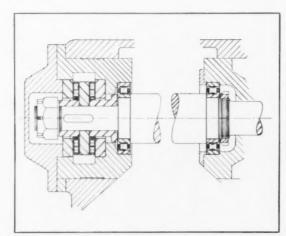
The right-hand end of inner sleeve is extended and heightened to contact rotating inner race of radial bearing (center left). Type ML radial roller bearing with sixteen 5/8- by 5/8-inch crowned rollers has double-flanged inner race and single-flange separable outer race. Radial capacity at 750 rpm is 6300 pounds.

Type MCS radial bearing on input shaft (right) is similar to Type ML in construction and capacity except that separable outer race is straight. Bearing capacity, size, and design may be modified to suit customer specifications.

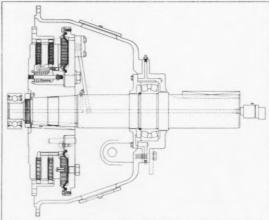
Circle Item 131 on postcard, page 259

Remote-Controlled Friction Power Take-Off

An air-operated, remote-controlled friction power take-off has been announced by the Twin Disc Clutch Co., Racine, Wis. This power take-off is available for use with engines up to 600-hp output in any industrial application where a standard power take-off is used. It combines the Twin Disc Model PO air clutch (replacing a mechanically actuated clutch) with the standard Twin



Rollway special double-acting thrust bearing for gear reduction units



Twin Disc air-operated, remote-controlled friction power take-off

Disc friction power take-off. Engagement and disengagement are accomplished by the turn of an air valve, rather than by a manually operated handle.

Air pressure of 90 to 100 psi will produce all the torque normally needed, but 130 psi air can be utilized if required.

Circle Item 132 on postcard, page 259

Precision Cylindrical Grinder

The Aaron Machinery Co., Inc., New York City, has introduced in this country an Overbeck precision cylindrical grinding machine which is adapted for a wide range of external and internal grinding work. It can grind work of the smallest diameter and has a maximum grinding length of 4 3/4 inches. Components up to 8 5/8 inches in length can be accommodated.

Bearings of the work-head spindle and grinding wheel spindles are adjustable and self-lubricating. Longitudinal movement of the grinding table is effected by a special drive which gives a uniform stroke speed with an accelerated reversal at the end of the stroke. The length of stroke can be adjusted accurately even for very short strokes from 0.004 inch. The longest stroke is 4 3/4 inches.

Different speeds can be selected electrically for the grinding table and the work-head. Thus, interchanging of high duty grinding spindles suitable for external and internal grinding at speeds up to 120,000 rpm presents no difficulty. The infeed of the grinding wheel is automatic and is adjustable from 0.00002 inch per stroke or double stroke. Provision is made for automatic fine adjustment of the cross-feed, with adjustable stop for finish sizing. Electromechanical control is provided for the work-spindle, longitudinal travel, and cross-feed speeds.

Circle Item 133 on postcard, page 259

Boring Head with Bore and Depth Control

A precision boring head combining positive size bore and depth control has been developed by Briney Mfg. Co., Pontiac, Mich. A patented feature permits adjusting the boring tool to a tolerance of 0.0001 inch without loosening or tightening any screws. The depth adjustment feature facilitates the setting of tools for controlling the bore depth. Tool wear is easily compensated for with this adjustment in both single- and multiple-spindle set-

Thus, operator can compensate for tool wear and positively maintain bore size and depth control by merely turning the calibrated adjusting collars with a spanner wrench. The whole boring head assembly is sealed against coolant and foreign particle infiltration. This construction permits coolants to be applied to the work directly from the machine spindle through the boring-bar.

Circle Item 134 on postcard, page 259

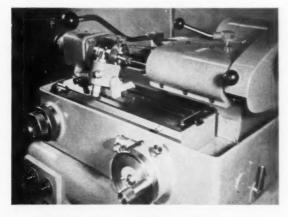


Royal Master centerless grinder

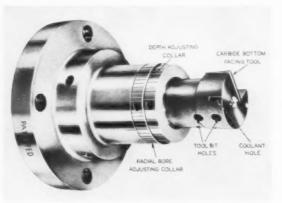
Royal Master Centerless Grinder

Exceptional versatility and accuracy are features claimed for a new TG-12 centerless grinder announced by Royal Master Inc., Riverdale, N. J. This machine is designed for centerless grinding of tungsten carbides, steels, plastics, ceramics, glass, hard rubber, carbon, wood, fiber, cork and nonferrous metals. Tolerances of 0.0002 inch are said to be easily maintained on this machine, and 6 to 8 micro-inch finishes are obtained in either production or single unit processing.

The machine handles work from 0.004 inch to 1 1/2 inches in diameter. It can be used for either



Overbeck precision cylindrical grinder introduced in this country by Aaron Machinery Co., Inc.



Briney boring head designed for bore and depth control adjustments

plunge or through-feed grinding with conversion to either method accomplished in a matter of minutes. A hydraulic system is incorporated in the machine for automatic cycling and wheel dressing. Circle Hem 135 on postcard, page 259

Open-Back Inclinable Press

The Johnson Machine & Press Corporation, Elkhart, Ind., has announced an open-back, inclinable press of 150-ton capacity, designated Model No. 150. This press has a box type ram, air clutch, air-actuated spring set brake, 110-volt electrical controls, and conforms to JIC standards. It is equipped with replaceable bronze inserts at the pitman and journal bearings. The standard die space is 22 inches, but a maximum of 39 inches is available on order.

Offered exclusively in the geared type, this press has a standard 6-inch stroke, but up to a 12-inch stroke is available. The flange ram face and box type ram measures 34 by 24 inches. The bolster plate is 50 by 30 by 4 1/2 inches.

Circle Item 136 on postcard, page 259



Nebel block gap lathe with block removed

Nebel Removable Block Gap Lathe

A newly designed block for removable block gap lathes has been announced by the Nebel Machine Tool Corporation, Cincinnati, Ohio. When the block is in place on the bed, a "gap" is intentionally left to accommodate the large faceplate. Thus, the large faceplate can be used for all chucking jobs, making it unnecessary to purchase or use a small faceplate, as was required with

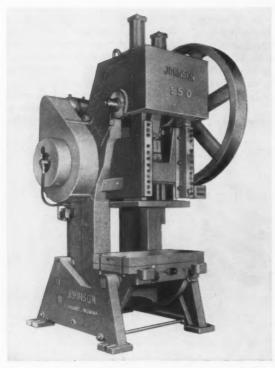
earlier models in which the block fitted snugly against the headstock. With the new gap block there is no sacrifice of gap-turning space since the distance from faceplate to end of gap remains unchanged.

Circle Item 137 on postcard, page 259

Automatic Balancing Machine

A fully automatic balancing machine designed to handle a wide range of work, including both rubber and metal automotive parts, has been developed by the Micro-Poise Engineering & Sales Co., Detroit, Mich. Tires, tire and wheel assemblies, brakedrums, and other parts can be balanced on this machine at a rate of better than 300 pieces per hour. It is claimed that automation obtained through the use of the machine has resulted in greater accuracy as well as increased production.

Application of a standard sensing device to the basic Micro-Poise wire-spring pivot movement serves to retain many of the advantages of standard machine



Johnson open-back inclinable press



Micro-Poise automatic balancing machine

economy. The sensing device transmits information with respect to amount and location of unbalance to electrically controlled correction or marking devices, as required. No special voltage regulation is needed, because normal main voltage fluctuations will not affect the accuracy of the machine.

Circle Item 138 on postcard, page 259

"Beko" Simplified Frame Balancing Machines

The Balance Engineering Co., Chicago, Ill., has announced the "Beko" Model F simplified frame balancing machine as an addition to its line of static and dynamic balancers. The Model F series balancers have weight capacities in various models, ranging from 1/2 ounce to 150 pounds. Magnitudes of unbalance are positively indicated by a large, easy-to-read meter, calibrated directly in terms of the unbalance correction procedure selected. Angular positions are accurately pointed out by a stroboscopic lamp and are readable at a location to either add or remove weight.

Circle Item 139 on postcard, page 259



Kaydon recently developed thin-shell needle roller bearing

Thin-Shell Needle Roller Bearings

The Kaydon Engineering Corporation, Muskegon, Mich., working with the Ford Motor Co., has developed a thin-shell needle roller bearing of new design. This bearing, using "spherical end" rollers, will be assembled in automatic and conventional transmissions, universal joints, steering gears, and clutches. Rollers of this type give maximum capacity in the available space, their rounded ends presenting smooth surface contact with the shell.

The shells are made of SAE 1010 steel hardened (carbonitrided) to Rockwell 60 C minimum. The rollers are made of SAE 50100 steel also hardened to Rockwell 60 C. These bearings are used with shafts of the same hardness to obtain maximum capacity and life. The two sizes now in production for the Ford and Mercury automatic transmissions are for shaft diameters of 1.0605 and 1.1875 inches with housing bores of 1.3130 and 1.5005 inches, respectively. The housings are 0.500 and 0.625 inch wide.

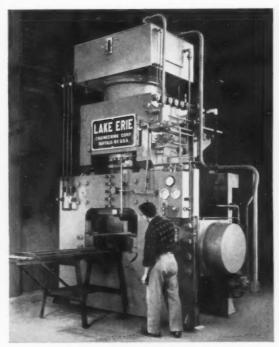
Circle Item 140 on postcard, page 259

One-Thousand-Ton Briquetting Press

The Lake Erie Machinery Corporation, Buffalo, N. Y., has brought out a 1000-500-ton angle molding type hydraulic press which is a departure from the line of conventional powdered metal presses. Although designed specifically for making 2 1/2- by 2 1/2- by 14-inch zirconium briquettes, the press can also be used for rectangular or square section shapes. The 500-ton horizontal die



Simplified frame balancing machine announced by Balance Engineering Co.



Hydraulic briquetting press brought out by the Lake Erie Machinery Corporation

sealing ram permits the use of split dies and facilitates removal of the briquette. The bed is provided with an opening through which material may be extruded.

The required rigidity is obtained through the front and back plate design. Travel of the top platen is accurately guided by adjustable vee type gib guides at the front and rear of the press. The capacity ratings are: vertical daylight, 22 inches with an 8-inch shut height; horizontal daylight, 28 inches combined with a 6-inch ram stroke; vertical platen size 30 by 34 inches front to back.

Closing speed of the vertical ram is 60 inches per minute, with a 5.4-inch-per-minute pressing speed. The horizontal ram closes and presses at the rate of 9.5 inches per minute. Operational control of both rams is by hand lever. The total weight of the press is 100,000 pounds.

Circle Item 141 on postcard, page 259

Improved Work Feeder with Air Cylinder

The Mead Specialties Co., Chicago, Ill., has announced an improved Model 43 work feeder equipped with a new type single-acting air cylinder. The air cylinder has been redesigned to take a larger diameter return spring.

The oilite bearing surface has been greatly increased to provide more accurate alignment of the ram, smoother travel, and less friction. The mounting surfaces are machined and ground true and parallel, ready to be assembled with other units with a minimum of make-ready.

Circle Item 142 on postcard, page 259

Dearbornaire Multiple-Amplification Contact Air Gage Cartridges

A complete line of multipleamplification Dearbornaire contact air gage cartridges for interchangeable use on any make or type of air gage instrument is announced by the Air Gage Division, Dearborn Gage Co., Dearborn, Mich.

Guaranteed as to accuracy and linearity, these cartridges are designed for use in checking hard-to-reach surfaces and relationship dimensions involving outside diameters, inside diameters, steps, eccentricity, concentricity, flatness, parallelism, and similar gaging applications. Their interchangeable use through multiple-amplification ranges eliminates using a specific cartridge for a specific tolerance range, and reduces the size of the inventory required with ordinary cartridges.

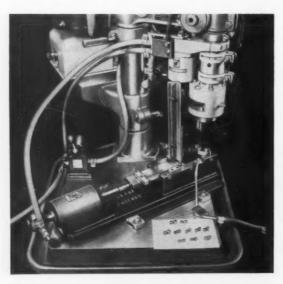
The line includes normal, short normal, and reverse cartridges which can be used interchangeably for 1500, 3000, and 6000 to 1 amplification ranges. In addition, a long-range, low-amplification cartridge for these amplification ratios and a square body type cartridge for simple fixturing applications are also available as standard items.

Circle Item 143 on postcard, page 259

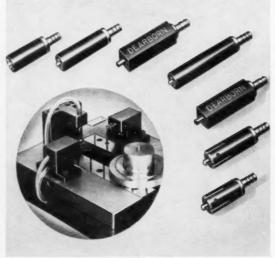
Heller Metal-Cutting Band Saws

A complete new line of "job tempered" metal-cutting band saws has been introduced by the Heller Tool Co., Newcomerstown, Ohio. In "job tempering," steel of carefully controlled analysis is heat-treated and tempered by a unique Heller process that is specially matched to the steel. This development produces blades which are said to offer exceptional cutting performance and long life under the severest working conditions.

The complete line includes both hard edge standard steel and high-speed steel saws. Standard tooth shape is provided for cutting most ferrous and hard, nonferrous materials. Skip tooth blades are furnished for cutting soft metals such as copper and



Mead work feeder combined with "Meadmatic" timer, drill press feed, and other standard Mead units



Multiple-amplification contact air gage cartridges made by Air Gage Division, Dearborn Gage Co.

aluminum, as well as wood, plywood, composition board, and plastics. Hook tooth saws for cutting gummy materials are also included in the line.

Blade widths range from 1/8 to 1 inch. Standard tooth blades are furnished with either regular or wavy set teeth. Skip and hook tooth blades are regular set only. All Heller saws are heat-treated for hardness along the toothed edge only, providing maximum wear resistance for the teeth and leaving the remainder of the blade flexible to withstand the constant bending over the band wheels.

Circle Item 144 on postcard, page 259

Special Automatic Indexing Machine

A special automatic indexing machine for use in the aircraft engine building field has been announced by the Hoefer Mfg. Co. This machine is built around two automatic drill units made by the Hartford Special Machinery Co., Hartford, Conn. Mounted on the horizontal Hartford unit is a two-spindle offset drill head which drills, spot-faces, reams, and hollow mills a group of bosses, two at a time, in the

horizontal plane. Since this group of bosses has two different levels, the unit automatically raises for the insertion of a spacer after the lower level of bosses is completed. The unit is again lowered and aligned with the upper level of bosses to complete operation.

The operations are accomplished in three passes. The first pass, drilling and spot-facing, is followed by a tool change, after which the cycle is repeated for the reaming operation. Again, the tools are changed and the

cycle repeated for the hollowmilling operation. The sealed, pumpless hydraulic system employed within the units provides the flexibility required for this job.

One additional cycle is made in which the vertical unit drills two 0.078-inch cross holes through the bosses at right angles to the horizontally drilled holes. The work-table is then moved forward for the removal of the piece, leaving the machine ready for a new piece.

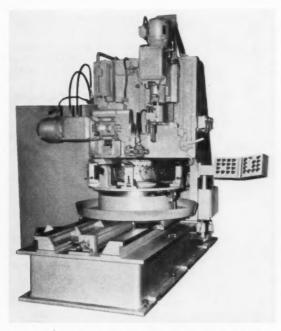
Circle Item 145 on postcard, page 259

Barnes Honing Machine for Small-Diameter Work

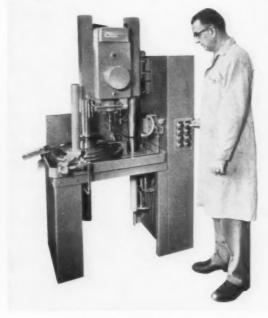
A line of honing machines for small-diameter work has been brought out by the Barnes Drill Co., Rockford, Ill. This line consists of four machines, although there are only two basic models. The Model 10A1 (shown in the illustration) has a 3/8- to 1-inch inside diameter range with a 10inch swing. The maximum spindle travel is 2 1/2 inches with a 6-inch lift-out stroke. Power is supplied by a 3/4-hp motor. Model 10M1 has the same capacities but is furnished without the automatic attachments. Models 15A2 and 15M2 have a 1/2- to 2-inch inside diameter range with a 15-inch swing. Maximum spindle travel is 6 inches with an 8-inch lift-out stroke. These models are powered by a 2-hp motor.

The machines are designed for manual or automatic honing with mechanical and pneumatic actuation. Compactness, versatility, and simplicity are features of the machines. The floor area required including electrical panel is only 32 by 34 inches to 42 by 63 inches for the largest model.

Versatility is made possible by adding automatic equipment such



Special indexing machine built around two Hartford automatic drill units



Honing machine for small-diameter work built by Barnes Drill Co.

as a rotary indexing table, magazine feed, gages and equipment for bore-to-bore sizing by fluid, plugmatic sizing or time cycle, pneumatic hone expansion with automatic rapid expansion, feed and collapse, postgaging, sorting, and ejection. Provision is made for automatic shut-down for continuous error or when stones are worn.

Circle Item 146 on postcard, page 259

Avey Hydro-Way Drilling Unit and Torque-Matic Attachment

A new "building block" unit for heavy-duty drilling, reaming, spot-facing, boring and counterboring, milling, and chamfering, named No. 4 Hydro-Way, is now in production at the Avey Division, Motch & Merryweather Machinery Co., Cincinnati, Ohio. This unit includes the following features: 5-to 20-hp drive; 12,000-pound maximum thrust; nonmetallic ways; hydraulic control panel which simplifies piping; and standard electrical components.

In addition, the unit provides positive depth control; adjustable coarse, fine, and jump feeds; 12-inch travel; simple cutting tool change because of long stroke; and separate pump and tank units to permit operation of additional hydraulic components from one central system.

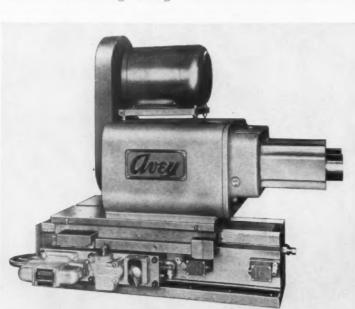
A new attachment, called Metric Torque-Matic, which eliminates drill breakage during deep-hole drilling, has also been announced. This attachment provides for the exact setting of torque on Avey deep-hole drilling units. The attachment is calibrated so that a number may be selected which corresponds to the desired drill diameter. This assures proper torque on the drill, which is automatically withdrawn any time this torque is exceeded.

Drill diameter charts corresponding with Metric Torque-Matic calibrations may be prepared on any drilling job. The operator simply checks the chart to find the correct setting.

Circle Item 147 on postcard, page 259

Red Ring Gear Gaging, Sorting, and Machine Control Unit

A Model GRF, Red Ring pedestal type gear gaging, sorting, and machine tool control unit for



Hydro-Way unit equipped with Metric Torque-Matic attachment announced by the Avey Division, Motch & Merryweather Machinery Co.



Red Ring pedestal type gear gaging, sorting, and machine tool control unit

gear production lines is available from National Broach & Machine Co., Detroit, Mich. The unit can be adapted to check size and helix angle accuracy of spur or helical gears. A model for hobbing machines checks and sorts gears for both size and helix angle accuracy. Another model for gear shapers and shaving machines checks and sorts gears for size accuracy only.

The gaging machine shown is a standardized Red Ring design which consists of a motorized gaging and sorting unit through which the gears are fed, one at a time, from an inclined feed chute. Gears that pass inspection travel through the machine into an inclined exit feed chute.

The gaging unit has a motorized lower master gear and a non-rotating upper master gear through which the production gears are passed for the gaging check. The upper master gear is pivoted in two planes to assure accurate size check without helix angle interference.

Separate electrical controls for the unit can be mounted at any desired location. Reject pans for gears that do not pass size or helix angle specifications are under the gaging machine. The unit automatically shuts down the machine after a predetermined number of reject parts are detected.

Circle Item 148 on postcard, page 259 (This section continued on page 234)

new design efficiency that delivers up to 80% faster production

BROWN & SHARPE AUTOMATICS for this FULL RANGE OF WORK SIZES

Now, right up the line, all Brown & Sharpe Automatic Screw Machines have the new design features that boost over-all efficiency 33\%% higher...production rates up to 80% faster than in models replaced.

No. 00 takes stock to ½"dia.

Spindle speed range 7200 to 34 rpm Turns any length to 1'' . . . with optional equipment, to $1\frac{1}{2}$ " Ratios, high to low speeds 2.3:1 to 16:1



up to 1/2"

up to

No. 2 - in THREE SIZES

Take stock to 3/4" dia. 11/4" dia. 11/2" dia

Spindle speed 5050 3500 2450 range to 25 rpm to 17 rpm to 17 rpm

Turn any length to 2½"... with optional equipment, to 3½" Ratios, high to low speed 2.2:1 to 15:1

up to 11/4'

up to 11/6"

No. 4 takes stock to 2"dia.

With outside feed, takes stock up to 23%" dia. Spindle speed range 1965 to 17 rpm Turns any length to 5" Ratios, high to low speeds 2.2:1 to 13:1

Get complete information. Compare for adaptability...precision... ease of set-up. Figure the big savings you could make, and you'll see why so many buyers say, "They pay for themselves, in record time." Brown & Sharpe Mfg. Co., Providence, R. I.



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MILLING, GRINDING, AND SCREW MACHINES . CUTTERS MACHINE TOOL ACCESSORIES . PRECISION TOOLS . PUMPS

Pratt & Whitney Specialty Gages

The Pratt & Whitney Co., Inc., West Hartford, Conn., announced six new products brought out by its gage division: a "Dual-Aire Air-O-Limit" comparator for closer control of high-precision production; an automatic radialplay gage which has a capacity of 1200 pieces per hour and is said to enable ball bearing manufacturers to maintain much more rigid quality control, as well as apply 100 per cent inspection faster and at less cost; a sigmatic multi-dimension automatic gaging machine, which solves the basic problem of 100 per cent inspection of parts requiring the accurate checking of several dimensions (will check up to fifty dimensions simultaneously with extreme speed and accuracy); a digital read-out supermicrometer to reduce to a minimum the element of human error in the most carefully planned quality control system; "Electrolimit" supermi-crometer, which is particularly useful at the machine on lapping, fine machining, grinding, and



"Dual-Aire Air-O-Limit" comparator made by Pratt & Whitney Co., Inc.

other precision work (now equipped with an Electrolimit tailstock and high-magnification instrument cabinet); and "Tri-Roll" thread comparator, which duplicates the three-wire thread measurement method.

The "Dual-Aire Air-O-Limit" comparator illustrated was one of the six new specialty gages which were displayed for the first time at the annual convention and exposition of the American Society for Quality Control at Detroit.

Circle Item 149 on postcard, page 259

Machines for Bonding Liners to Automotive Parts

Equipment developed recently by the Modern Industrial Engineering Co., Detroit, Mich., for rapid bonding of liners to automatic transmission parts includes a line of multi-station rotary bonding machines such as the twenty-station model shown in Fig. 1 and a compainon preliminary cold-assembling press, Fig. 2.

Each station completes a part in six minutes for a production rate of 200 parts an hour. The special cold-assembling press shown in Fig. 2 locates, positions, and preliminarily bonds a cone-shaped molded liner to the conical surface of a piston ready for the final bonding operation on the machine shown in Fig. 1.

In the cold-assembling operation, the piston and liner, pretreated by using oven-dried cement and a solvent activator, are placed on the lower platen of one station of the press, Fig. 2, and finger-positioned together. Both parts are held by a retaining collar. The automatic cycle then takes over, with the press ram being lowered against an expandable neoprene mandrel to axially produce pressure about the entire liner area. This action provides positive location and avoids any danger of securing the liner in an elliptoid position. A holding pressure of about 400 psi is then applied by the ram and maintained for a predetermined and variably controlled cycle. Ram return is automatic. The operator loads one station while the other station is in operation.

The final bonding machines are offered in a capacity range of from single and multi-station stationary types and up to forty-station rotary types for permanently bonding liners (using a commercial adhesive) to either internal or external surfaces.

Circle Item 150 on posicard, page 259 (This section continued on page 238)



Fig. 1. Twenty-station automatic bonding machine developed by the Modern Industrial Engineering Co.

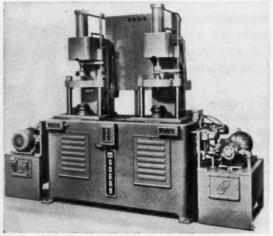
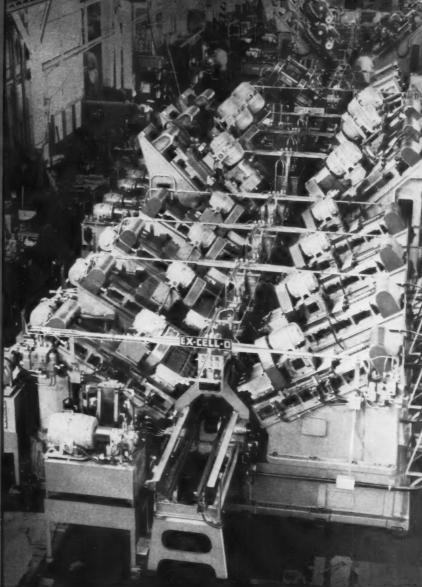


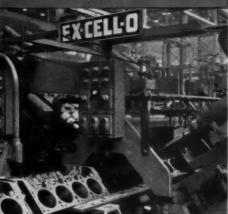
Fig. 2. Special cold-assembling press—companion equipment for bonding machine shown in Fig. 1.



3000 Engine Blocks Per Day -

How one company competes in the world's toughest market...





The photograph above is a view in the auto plant shortly after the automation line was installed. At right above, a portion of the line as it neared completion in the Ex-Cell-O plant.

These Ex-Cell-O automation machines play an important part in turning out engine blocks for one of the "big three" of the automotive industry. This manufacturer's engine must compete in one of the toughest markets in the world.

Ex-Cell-O's part in the manufacturing process is 1200 feet of production line using the newest machines in assembled integrated units. Among the precision machining operations performed are boring, broaching, chamfering, milling, reaming and grooving.

Ex-Cell-O—builders of standard and special machine tools for 25 years—uses standard bases and subassemblies wherever possible. This means that product changes do not necessarily obsolete equipment. You save, too, in initial cost.



MANUFACTURERS OF PRECISION
MACHINE TOOLS • GRINDING
SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL
JIG BUSHINGS • AIRCRAFT AND
MISCELLANEOUS PRODUCTION
PARTS • DAIRY EQUIPMENT

Chips flow freely, since chip driver contours are always of exact size, shape, and position.

BALANCED ACTION TAPS cut clean-always!

When you know that a tap has been manufactured with great care and skill—you're assured of closely controlled hole size and long tool life. Only Winter makes taps with Balanced Action. They give clean-cutting performance—always.

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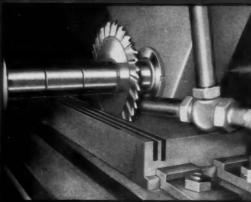
Distributors in principal cities. Branches in New York

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Division of National Twist Drill & Tool Co.



National



The search that never ends

Finding the best way to do a deep slotting job in the National research laboratory.

National will have the right one

National's complete line of tools can save you time and tool-life. For instance—just tell National about your sawing or slotting job. You'll get a tool that is sized, styled, and designed to do the best job.

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CALL YOUR NATIONAL DISTRIBUTOR TWIST DRILLS . REAMERS . COUNTER-

BORES • MILLING CUTTERS • END MILLS • HOBS • CARBIDE AND SPECIAL TOOLS

Reliance Right-Angle Gear-Motor, Variable-Speed Electronic Drive and Reeves Motodrives

A line of space-saving, rightangle gear-motors with heavy load-carrying and shock-absorbing qualities for industrial applications has been introduced by the Reliance Electric & Engineering Co., Cleveland, Ohio. These gear-motors, Fig. 1, in 1- to 10-hp sizes for continuous-duty applications, and in 1- to 30-hp sizes for intermittent duty are now available with such features as horizontal or vertical mountings, conventional double shaft, and hollow shaft to fit all types of applications calling for reduced speeds. The gear-motors can be supplied with either an alternating- or direct-current speed or duty rating, and any standard type of enclosure-protectedopen, totally enclosed, or explosion-proof. The footless motor, with D-flange and modified shaft, is bolted directly to a flange that is cast with the gear housing.

A redesigned Reliance VS Jr. variable-speed electronic drive, not illustrated, was also announced recently. This drive with its maximum size boosted from 3 hp up to 4 hp gives wider application coverage than preceding models. The compact, packaged electronic drive consists of a rectified-power control panel, an operator's station, and a variable-speed drive motor. Available in 220- and 440-volt models in sizes from 3/4 through 4 hp, it gives wide-range adjustable speed.

At the twist of a simple rheostat control, this drive will operate from a speed as low as 23 rpm for intermittent setup duty, or up to 2300 rpm for high-speed produc-



Fig. 1. Reliance right-angle gearmotor designed for heavy loads

tion. It can be plugged into the alternating-current power line of any plant (an autotransformer is available for use on 110-, 380-, or 550-volt power sources) and it instantly produces adjustable drive speeds requiring no motorgenerator sets, direct-current lines, or mechanical devices.

The Reeves Vari-Speed Motodrive, Fig. 2, is another product being introduced. Improved operating efficiency and extended ratios of speed variation are features of this new model. Each



Fig. 2. Reeves Vari-Speed Motodrive

size is available in standard assemblies tailored to fit a wide range of space requirements.

Circle Item 151 on postcard, page 259

Keyless Drill Chucks

The Jacobs Mfg. Co., West Hartford, Conn., exclusive distributor in the United States and Canada for the Albrecht keyless drill chucks, has announced that its dealers throughout this country and Canada will have available eleven heavy-duty models of the Albrecht keyless drill chucks with capacities ranging from 1/8 to 5/8 inch and a special small drill chuck with a capacity of from 0 to 1/16 inch for small drill presses operating at high spindle speeds. The company will also carry a substantial stock of repair and replacement parts at its



Albrecht keyless drill chuck distributed by the Jacobs Mfg. Co.

West Hartford plant and has set up a special service department for prompt repairs on Albrecht chucks.

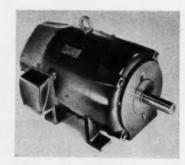
These chucks are designed for use on the finest precision drilling machinery where close-tolerance drilling is essential. Working parts are of alloy steel, expertly hardened, and the keyless construction permits very rapid drill changes. The chucks are furnished with standard Jacobs taper backs.

Circle Item 152 on postcard, page 259

Westinghouse Industrial Direct-Current Motors and Generators

A new ventilating system, improved commutating ability, and reduced armature inertia are said to work together for greater dy-

(Continued on page 244)



Direct-current "Life-Line" motor introduced by Westinghouse Electric Co.



to lowest-cost

parts duplication with

CINCINNATI HYDRAGUIDE TRACER LATHES

"Head of the Class" Engineering-

Compact design provides shortest hydraulic linkage for more sensitive control . . . requires no additional floor space. Tool is accurately guided by sensitive stylus following the easily-accessible flat template. Automatic duplication . . . less operator attention . . . lowest tooling cost . . . minimum tool setting . . . less scrap . . . lowered cost per piece!

Just push this button to provide lowest-cost tracer machining on these new Cincinnati Hydraguides[®]... yet there is no interference with standard lathe operation. Everything is on the carriage, but nothing is in the way. All controls, template and tool are on the operating side for maximum convenience.

All the proven Tray-Top features are included, of course . . . PLUS an increase to 5 HP for even greater performance. Here is NEW versatility . . . NEW convenience . . . NEW profit possibilities. And it's *still* an ECONOMY-PRICED lathe!

Ask your C L & T Dealer for the Hydraguide story. Write today for full data—catalog H-150. Cincinnati Lathe and Tool Co., 3207 Disney Street, Cincinnati 9, Ohio.





surest thing in measuring-

There's never an argument when it comes to precision measuring tools. Just specify STARRETT and you'll please everyone in the shop—from the tool crib supervisor to the rawest apprentice.

But why stop with measuring tools when there are so many opportunities to get the same quality and dependability in so many other Starrett products? Did you know, for example, that Starrett makes the world's most complete line of dial indicators and

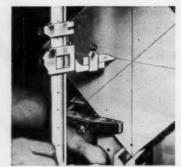
dial gages? Or that Starrett is among the largest producers of hacksaws, hole saws, band saws and band knives? Or that Starrett makes precision ground die and flat stock in over 1000 sizes?

Your Industrial Supply Distributor stocks the complete Starrett line. He can give you prompt, dependable service to match the quality and dependability of Starrett products. It pays in so many ways to specify Starrett.

NEW CATALOG No. 27

Shows the complete Starrett line. Ask your Industrial Supply Distributor or write for free copy. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U.S.A.





HAND MEASURING TOOLS AND PRECISION INSTRUMENTS The name Starrett on a tool guaran'ees accuracy, fine workmanship and complete

dependability.



DIAL INDICATORS AND GAGES
Standard for quality and dependability—
a complete line for every gaging or production inspection application.



HACKSAWS, BAND SAWS,
BAND KNIVES
Precision made and production proved for top performance, uniformity and maximum



AND FLAT STOCK

Now over 1000 sizes — air, oil, oil and
water and water hardening types. "Just lay
it out and saw it out."

AMERICAN STANDARD FORMULAS FOR NUTS-2

	WIDTH AC	WIDTH ACROSS PLATS	THICK	THICKNESS OF NUT
TYPE OF NUT	BASIC ¹	TOLERANCE (Minus)	NOMINAL ²	TOLERANCE (Plus or Minus)
Heavy Hexagon Heavy Square	1½D + %	0.050D	Q	Plus tolerance only 0.016D + 0.012 Minus tolerance adjusted so that minimum thickness is equal to minimum thickness of heavy semi- finished hexagon nut.
Heavy Hexagon-Jam	1½D + ½	O.050D	% to 1% %D + %s 1% to 2% %D + % 2% to 4 %D + %	Plus tolerance only 0.016D + 0.012 Minus tolerance adjusted so that minimum thickness is equal to minimum thickness of heavy semi- finished hexagon-jam nut.
Heavy Semi-Finished Hexagon Heavy Semi-Finished Hexagon Slotted	1½D + 1%	0.050D	12 to 1% D - 1/c4 11/2 to 2 D - 1/c4 22/2 to 3 D - 2/c4 32/2 to 4 D - 2/c4	0.016D + 0.012
Heavy Semi-Finished Hexagon-Jam	1½D + ½	0.0500	24 to 14	0.016D + 0.012

All dimensions given in inches.

Adjusted to extreenths.

Adjusted to fractions.
D = Nominal nut size.
W = Width across flats.

For all hexagon nuts, max. width across corners equals For 1.1547 × W (max.) and min. width across corners 1.4 equals 1.14 × W (min.)

HEXAGON

equals For all square nuts, max. width across corners equals 1.4142 × W (max.) and min. width across corners equals 1.373 × W (min.)

SQUARE

WIDTH ACROSS CORNERS

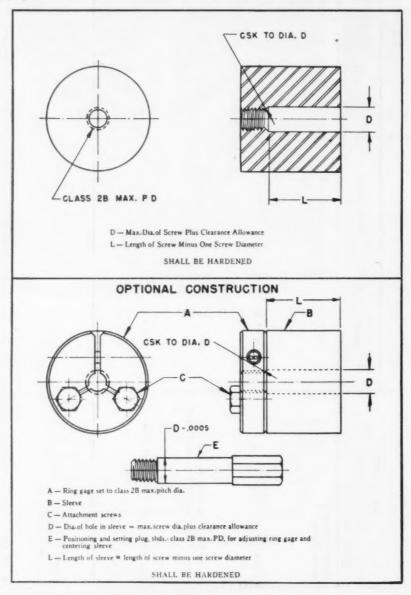
Extracted from American Standard Square and Hexagon Bolts and Nuts (ASA B18.2-1955), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

AMERICAN STANDARD THREAD-RUNOUT SLEEVE GAGES

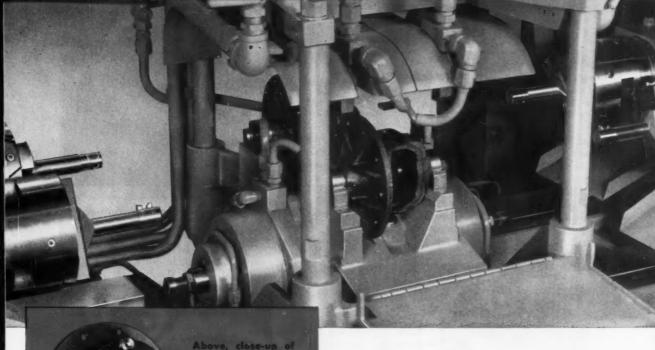
Sleeve gages capable of checking the thread eccentricity and bow of shank on Finished Hexagon bolts are illustrated in the following cuts. The optional construction permits the use of different length sleeves to accommodate different bolt lengths.

Ring gage A in the optional construction is centered in position on sleeve B by means of positioning plug E and is secured in position by

means of attachment screws C. The ring gage is also set to maximum P.D. by positioning plug E. The internal diameter D of the sleeve equals the nominal diameter of the bolt plus runout allowance. The sleeve should extend beyond the last thread of the bolt to be inspected but should not exceed 3 in. in length. Failure of the bolt to enter the ring gage or interference between the sleeve and bolt while engaging the ring gage indicates excessive thread runout.



Extracted from American Standard Square and Hexagon Bolts and Nuts (ASA B18.2-1955), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

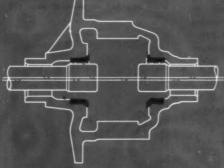




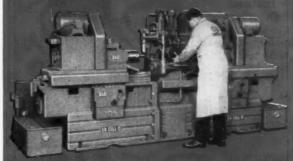
Above, close-up of parts in fixture.

Overhead air clamps in position for loading and unloading.

Part shown at left.



Internal boring and chamfering cuts indicated by black lines. Tolerances are held to ± .0005°.



Ex-Cell-O Two-Way Precision Boring Machine ups production, increases accuracy.



EX-CELL-O FOR PRECISION

Increases Production, Keeps Accuracy

Back-bores and Chamfers Differential Cases

If you want to increase production, yet maintain .0005" accuracy, get an Ex-Cell-O Two-Way Precision Boring Machine. That's the opinion of an automobile manufacturer.

Right now this machine is performing back-boring and chamfering operations inside steel automotive differential cases for this company. Boring bars enter the case on the center line of the bores, then move 5/32" off center, perform the cutting operations, then withdraw after returning to the center line. Two cases are machined at the same time.

Ex-Cell-O Way Machines perform as one, two, three, and four-way assemblies with exceptional versatility.

These machines adapt smoothly into automated lines, too. See your Ex-Cell-O representative or write Ex-Cell-O, Detroit.

EX-CELL-O CORPORATION P DETROIT 32, MICHIGAN

Machinery

Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

namic response in a new line of direct-current industrial motors and generators known as the Life-Line "H" series announced by the motor department of the Westinghouse Electric Corporation, Pittsburgh, Pa. These motors and generators are designed to be equally effective as basic prime movers or as elements of highly complex automatic production systems. They have dripproof enclosures as standard and bear NEMA Class B ratings; they span motor ratings from 1 to 150 hp and generator ratings from 3/4 to 100 kw.

Circle Item 153 on postcard, page 259



Automatic Air-Operated Tape Dispensers

One of a series (four models) of fully automatic, air-operated tape dispensers for industry brought out by Air Fixtures, Inc., North Manchester, Ind. This dispenser has no push-buttons, levers, or foot pedals. When the operator removes a length of tape, a micro switch automatically sets in motion the next delivery cycle. Available for all types of pressure-sensitive tape in widths up to 4 inches and lengths up to 21 inches.

Circle Item 154 on postcard, page 259

Heavy-Duty Carbon Dioxide Regulator

Oxweld R-68-400 heavy-duty carbon dioxide regulator introduced by Linde Company, Division of Union Carbide Corporation, New York City. Designed for use on carbon dioxide cylinders or mani-



folds, the new regulator is said to have the largest capacity and widest work range of any CO2 regulator now available. Effective operation is possible at any delivery pressure up to 200 psi. These features, combined with extremely sensitive control, adapt the regulator to a wide range of applications from control of delivery rates for pressurizing premix containers to regulating CO2 in core-molding operations in foundries. The regulator operates on a two-stage principle of pressure reduction. Cylinder pressure is first reduced to a steady, intermediate stage and then to the desired delivery pressure. A porous filter in the inlet connection blocks and absorbs any dirt or dust that might affect valve seating.

Circle Item 155 on postcard, page 259

Whitman & Barnes Extra-Length Drills

One of a complete line of highspeed steel extra-length drills announced by Whitman & Barnes, Plymouth, Mich. These drills are designed for operations where inaccessibility is a problem or for drilling extremely deep holes. Either straight or taper shank styles in wire gage or fractional sizes are available. Diameters range from No. 52 wire gage to 1 1/2 inches, and over-all lengths to 23 1/2 inches. Larger diameters and longer lengths can also be furnished on order.

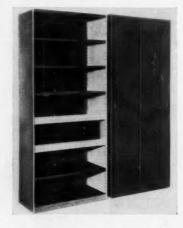
Circle Item 156 on postcard, page 259



Taft-Peirce Permanent Magnet Chuck

Model 824 permanent magnet chuck made by the Taft-Peirce Mfg. Co., Woonsocket, R.I., features 100 per cent all-over holding power. Special Alnico V-chuck design is said to eliminate all dead spots and provide full edge-toedge usable surface. The new style faceplate uses a special epoxy resin, non-magnetic separator material which provides unusual faceplate stability and makes the chuck 27 per cent lighter. The chuck is only 2 7/18 inches high, has a work surface 8 by 24 inches, a magnetic surface area of 168 square inches; and weighs only 110 pounds.

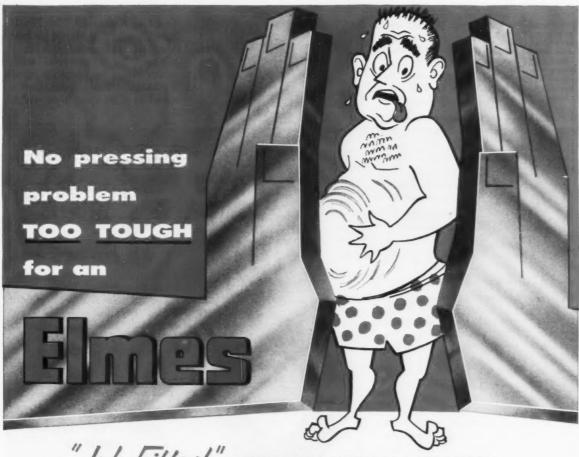
Circle Item 157 on postca d, page 259



"Erectomatic" Steel Shelving

Hallowell "Erectomatic" steel shelving that can be erected in about half the time required to assemble conventional units. This shelving has been introduced by the Standard Pressed Steel Co., Jenkintown, Pa. It features a locking device which holds each shelf



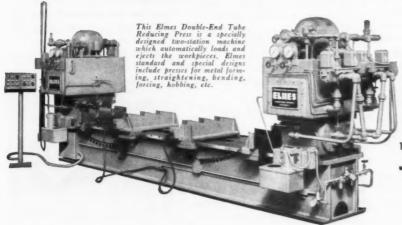


"Job-Fitted" HYDRAULIC PRESS

Is a "troublesome shape" getting you in a squeeze? Tough production problems involving unusual shapes are often "old hat" to Elmes engineers—situations made to order for Elmes ingenuity in helping with consultation and recommendations.

Sometimes a standard design Elmes® Press, or a simple adaptation of it, will handle the customer's requirements. Sometimes the work to be performed involves development of a special custom-built press. But, whatever it takes, Elmes is equipped to provide the right press for the job!

It just makes sense to take advantage of the best of someone else's experience—particularly when it is backed up by more than 60 years of leadership in specialized hydraulic service. Whatever your pressing problem, it will pay you to call in Elmes. See your nearby authorized Elmes distributor, or write to us direct.



American Steel Foundries

Elmes ENGINEERING DIVISION

ENGINEERING DIVISION

1162 Tennessee Ave., Cincinnati 29, Ohio

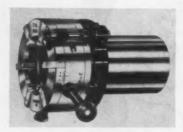
- METAL-WORKING PRESSES
 ACCUMULATORS
 - PUMPS PLASTICS MOLDING PRESSES

For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-245

firmly in place, yet permits any shelf to be removed or repositioned in a matter of seconds without the use of tools. The illustration shows a closed shelving unit without doors and a unit equipped with sliding doors.

Circle Item 158 on postcard, page 259



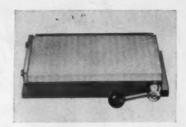
Geometric Die-Head with Convertible Trip

Convertible trip die-head brought out by the Geometric Tool Co. Division, Greenfield Tap & Die Corporation, New Haven, Conn. This die-head incorporates features of the "DSA" die-head and is especially designed for use on the No. 4 Brown & Sharpe automatic. The shank, as shown in the illustration, is of maximum size and is altered to the 1 3/4-inch diameter size when used on the Brown & Sharpe No. 4 machine. The 2 1/4-inch "DSA" convertible die-head will take the full capacity of the Brown & Sharpe No. 4 screw machine. This 2 1/4-inch size is equipped with both an outside trip for short length and finepitch shoulder threading and a pull-off trip for longer threads, providing ample chaser engagement for tripping. Conversion from one trip to the other is quickly and easily accomplished. The alignment shank feature is standard on all "DSA" die-heads.

Circle Item 159 on postcard, page 259

Walker Permanent Magnetic Chuck

Multi-pole, fine-division, permanent magnetic chuck of line introduced by the O. S. Walker Co., Inc., Worcester, Mass. This chuck has fine pole divisions with characteristics developed to equal those of electromagnetic chucks. This desired quality is said to



have been obtained largely by the use of a ceramic magnetic material never before employed in this field. The chuck is being made in three sizes—6 by 10 1/2 inches, 6 by 12 1/2 inches, 6 by 18 1/2 inches, with heights of 2 1/8, 2 1/8, and 2 3/8 inches, respectively.

Circle Item 160 on postcard, page 259



Simonds DA Borolon Abrasive Wheel

High - speed, resinoid - bonded snagging wheel made with improved type aluminum oxide abrasive by the Simonds Abrasive Co., Philadelphia, Pa., for use in steel mills and foundries. The fused crystalline aluminum oxide, has a small crystalline structure within each cutting particle that provides greater resistance to fracture and, at the same time, presents a continuous succession of more and sharper cutting edges on the wheel face.

Circle Item 161 on postcard, page 259

Thor Portable Sander

Universal electric portable sander combining high work capacity with light weight, recently added to the line of orbital "Speed-Sander" made by the Thor Power Tool Co., Aurora, Ill. This No. 16 Speed Sander is designed for both home and industrial use. It is powered by a universal series wound motor for operation on alternating or direct current at a speed at 6200 rpm. Tool weighs



approximately 5 pounds and has a sanding area 4 1/2 by 5 1/8 inches. It is available in kit form which includes eighteen aluminum-oxide abrasive sheet covers, a permanent type template, two free abrasive felt pads, neoprene contour pad, lamb's wool cover, and fitted steel carrying case.

Circle Item 162 on postcard, page 259

Pic Precision Flexible Coupling

One of a complete line of precision flexible couplings made by the Pic Design Corporation, East Rockaway, N.Y. These couplings are made of No. 303 stainless-steel hubs, precision bored to 0.0002 inch tolerance, and come in three shaft sizes—1/8-, 3/16-, and 1/4-inch diameters. The centers are of molded neoprene. The couplings control shaft-to-shaft misalignment and isolate torsional vibration.

Circle Item 163 on postcard, page 259 (This section continued on page 248)



Major chemical producer meters flow of catalytic agents with Cleveland Speed Variator

A chemical research worker adjusts the manual centrol knob on the Cleveland Speed Variator to set the metering speed. Various types of regulating mechanisms can be mounted on the Variator to provide automotic adjustment by remote control.



IN the research department of a major chemical plant, catalytic agents are metered and their flow varied with precision accuracy. This control is exercised with a Cleveland Speed Variator.

A ¼-horsepower electric motor is connected to the Cleveland Speed Variator driving a pump through a 25-1 speed reducer. Being infinitely variable, the Variator gives stepless speeds over its full 9:1 range—from ¼ to 3 times input speed. Pumping speed can be varied from 207 to 23 rpm. This provides the necessary speed range for metering the various types of catalytic agents.

Available in eighteen standard types and sizes, the

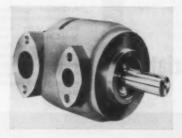
Cleveland Speed Variator offers these major advantages: 1. An extremely compact unit; 2. Almost any input speed up to 1800 rpm—clockwise or counterclockwise; 3. Constant horsepower output over a 9:1 range, or constant output torque with a 6:1 range; 4. Infinitely variable over entire speed range; 5. Rapid response to speed change, precise adjustment, accurate maintenance of settings; 6. Long life and minimum maintenance; 7. Ample bearing support for overhung pulleys on either input or output shafts.

Write for Bulletin K-200 for detailed description of the Cleveland Speed Variator, with photographs, sectional drawings, rating tables and specifications.

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3276 East 80th St., Cleveland 4, Ohio

Sales representatives in all major industrial markets. In Canada-Peacock Brothers Limited.



Denison High-Pressure Vane Pump

One of a new series of balancedvane hydraulic pumps for continuous 2000-psi service announced by the Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio. The pumps in this "T" series are of special construction featuring Denison's exclusive hydraulically balanced vane and are available in rated delivery capacities up to 100 gallons per minute at speeds up to 1800 rpm.

Circle Item 164 on postcard, page 259

Improved Dimensionair Air Gage

Improved model Dimensionair air gage announced by Federal Products Corporation, Providence, R. I. This gage uses the same balanced measuring system as preceding Dimensionair gages and is said to be even less sensitive to outside airline conditions and handling faults. Oil and water seepage into

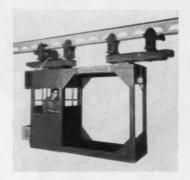


the gage from the airline has been minimized and a new, efficient filter is mounted on the gage itself. A transparent cup makes it easy to observe the contents of the filter and to judge the condition of the airline.

Circle Item 165 on postcard, page 259

Air-Conditioned Tramrail Carrier

Air-conditioned carrier for operation on overhead tramrail systems made by the Cleveland



Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Although this carrier was designed especially for conveying ladles of hot metal used for die-casting, the platform can be changed in size and adapted for other materials-handling purposes. The carrier illustrated has a cab enclosed with aluminum paneling and is provided with air-conditioning to keep the operator comfortably cool while transporting molten metal. The door has a safety switch that prevents the carrier from being moved when the door is open. The unit has a capacity of 3100 pounds and travels at speeds up to 300 feet per minute. Carriers of other capacities and speeds can be furnished to order. Circle Item 166 on postcard, page 259

Damascus Drawing Lead Holder for Designers and Draftsmen

A Damascus lead holder for designers, engineers, and draftsmen, which has a hardened steel clutch that grips the lead securely and re-



sists abrasion of sandpaper or files used in sharpening the lead, has been brought out by the Richard Best Pencil Co., Inc., Springfield, N. J. The holder is all-metal for dimensional stability and has a spring-loaded release mechanism with release buttons anodized in red, blue, or yellow colors for quick identification of the holder loaded with lead of the desired hardness for a specific drawing job. This holder is perfectly balanced and designed for a lifetime of dependable service.

Circle Item 167 on postcard, page 259

Sheffield Precisionaire Face Flatness Gage

Precisionaire pneumatic gage manufactured by the Sheffield Corporation, Dayton, Ohio, for checking flatness of a transmission bowl flange at nine places simultaneously. Four locators (black plugs) orient the part in the correct gaging position. The part is

(Continued on page 250)



why General Mills checks every precision production gear on the S&F gear tester...



GRAPHOTEST

ONE REV

64P 20° 108T

TCE .0003

TTCE .0002

because...

there's no gear tester as accurate as the S & F

Checking gears by the usual methods just isn't accurate enough to satisfy so precision-minded a producer as the Mechanical Division of General Mills. They know that their gears can be only as accurate as the instruments that test them—and only the S & F Gear Tester measures up to the highest precision standards.

Strong statement you say? Several hundred S & F Testers prove it every day in plants that took their gear accuracy seriously enough to change over to S & F—guaranteed to repeat within .00002".

Ask us to show you why this instrument is revolutionizing gear checking. Or talk to the S & F user near you. We'll send you his name.



42 Exchange Place, Jersey City 2, N. J. • In Canada: 2490 Eglinton Ave. W. Toronto

lowered onto three rest buttons, and the flange face contacted by nine Plunjet gaging cartridges whose gage points extend slightly above the surface of the gage plate. Flatness or the amount of concavity or convexity is indicated by the relative float positions in the nine Precisionaire columns.

Circle Item 168 on postcard, page 259

Assembly Tool for Truare Grip-Ring

Waldes Truarc grip-ring assembly tool made by Waldes Kohinoor, Inc., New York City. This tool is designed for spreading Truarc Series 5555 grip-rings to the exact diameter required for installation. It automatically prevents over-



spreading and subsequent permanent set, and is intended for removing as well as assembling Truarc rings. The tool is available in three sizes for seating rings on shafts 5/32, 3/16 and 1/4 inch in diameter.

Circle Item 169 on postcard, page 259

Dodge Double-Strand Taper-Lock Sprocket

Double-strand type roller chain sprocket that requires no reboring or other machining for installation



on shafts recently added to the line of Taper-Lock sprockets made by the Dodge Mfg. Corporation, Mishawaka, Ind. This sprocket provides the equivalent of a shrunk-on fit, regardless of whether the shaft is turned and ground or cold-rolled, standard or normally under-sized. The new double-strand, taper-lock sprockets are now being manufactured and are available in pitch sizes ranging from 1/2 to 1 inch.

Circle Item 170 on postcard, page 259



Lufkin Lightweight "Executive Thinline" Tape Rule

Tape rule with 1/4-inch wide blade, called "Executive Thinline," announced by the Lufkin Rule Co., Saginaw, Mich. This tape rule is an addition to the Lufkin "White Clad" series and is available in both 6- and 8-foot lengths. The rule is compact, about the diameter of a silver dollar, and is of extremely light weight. It has a highly polished bright chromium finish on a smoothly contoured steel case of attractive design.

Circle Item 171 on postcard, page 259

Criterion Cut-Off Tool with Carbide-Tipped Blade

Cut-off tool with carbide-tipped blade announced by the Criterion Machine Works, Costa Mesa, Calif. The blades may be purchased separately and used with all Criterion standard holders of the type illustrated. The cutting widths will remain the same as the high-speed blades previously introduced. The 0.060-inch wide sizes will part stock 1 1/2 inches in diameter and the 0.090-inch



wide size handles stock up to 3 and 4 inches in diameter. A heavy-duty model for parting or grooving 4-inch diameter stock of materials containing properties that make machining difficult and a larger tool capable of parting stock up to 6 inches in diameter are also available. Blades for these latter tools are available in both high-speed and carbide in cutting widths of 0.090 inch for the 4-inch capacity, and 0.125-inch widths for the 6-inch capacity tool.

Circle Item 172 on postcard, page 259

Wesson Micro-Adjustable Boring-Bar

Micro-adjustable boring-bar available from the Wesson Co., Ferndale, Mich. Changing from a turning to a threading or facing operation or, from one requiring triangular inserts to round or square throw-away inserts, can be accomplished with these microadjustable boring-bars. The complete tool change-over requires only the interchanging of one piece-the standard anvil. The rest of the boring-bar (including chip-breaker clamp and microadjustment) requires no changing. Circle Item 173 on postcard, page 259



Machining Titanium at Lower Cost with Throw-Away Carbide Insert Tooling

V-R Face Mill Cutters Save \$169.60 In Machining 1186 Cu. In.

A change from brazed tipped tools to throw-away insert carbide tooling has effected major economies in machining titanium at Convair Division of General Dynamics Corporation (San Diego Plant II). Following is a typical example.

Job: Machining AMS 4925 titanium bar stock on Cincinnati vertical mill. Depth of cut from .08' to .220'. Feed .004 IPT. Speed 95 RPM (100 SFM). Total stock removal 1186 cubic inches. V-R grade 2A5 carbide throw-away inserts.

COST COMPARISON

	Old Method	New Method				
Tool	Brazed tip cutter	Vascoloy-Ramet 4" dia., 30° lead angle neutral rake cutter with V-R Grade 2A5 %" square carbide throw-away inserts				
Stock removal per cutting edge	25 cu. in. per grind	99 cu. in. per corner (4 usable corners)				
Carbide cost	\$20.00	\$33.60				
Regrind cost	\$94.00	None				
Downtime	470 minutes for cutter changes—\$94.00	24 minutes for insert changes—\$4.80				
TOTAL COST Tool repair and downtime	\$208.00	\$38.40				

For complete data on cost-saving V-R throw-away insert style face mill cutters, ask for Bulletin VR-571; for single point toolholder data, Catalog VR-437. Call your local V-R Representative or Distributor, or write:



Convair-built F-102A supersonic jet interceptor incorporates many titanium parts.



 $\mbox{{\it V-R}}$ throw-away insert face mill cutter machining titanium at Convair Division.



V-R toolholder and carbide insert turning titanium at Convair Division.



Display of typical Vascoloy-Ramet throw-away insert type tools used at Convair Division.

Comented Carbides • Tantung Cast Alloys
Toolholders • Carbide Cutting Tools

858 S. Market Street Waukegan, Illinois



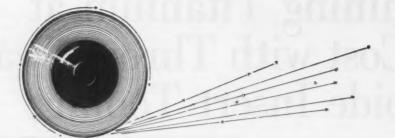
Vascoloy-Ramet Corporation

SUBSIDIARY OF FANSTEEL METALLURGICAL CORPORATION

For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-251





BETWEEN GRINDS

Did You Flash, Sir?

Medical researchers have devised a "radio pill." a plastic capsule that sends out FM signals as it passes through the human body. It is the world's smallest FM radio broadcast station, according to Industrial Research Newsletter (published by Armour Research Foundation of Illinois Institute of Technology).

Bonanza at Bat Cave

In the depths of the Grand Canyon is a prehistoric treasure of guano, valuable as a fertilizer and source for drugs, now made accessible by engineers of the United States Steel Corporation. An aerial freight tramway was devised, one of the most difficult phases of the operation being the stringing by helicopter of 11,500 feet of 1/8-inch construction cable across the 2911foot gorge in which Bat Cave is located. The cave, its entrance situated about 600 feet up the precipitous canyon wall above the Colorado River, was discovered in the 1930's, but only recently was this economic method of removing the deposit developed. The guano will be picked up by a giant vacuum cleaner; the deposit is estimated as worth at least \$10,000,000. We wouldn't mind emptying our vacuum cleaner bag on those terms.

Explosive Wall—and Words

Firemen summoned to a house by an excited housewife who claimed her kitchen wall was roaring discovered, and without using their axes, the source of the noise. A diningroom chair was resting on the floor service button designed to ring a buzzer in the kitchen.

Flier of Wire

A bird in Fort Wayne, Ind., has designed a durable nest for himself and family. He gathered tiny strands of stainless-steel wire at Fort Wayne Metals, Inc., which makes unusually fine filters. Allegheny Ludlum Steel Corporation supplies the stainless to them, as well as to the bird, it seems.

Coupon-Come-Lately

The Landis Tool Co. recently received a coupon cut from an advertisement that had appeared in September, 1951, Machinery (how we stay around), offering a copy of a Landis pamphlet, Better Grinding. The clipping came from a New Yorker to whom it had been sent by a friend in Israel.

Uncle Sam's Great Anti

As of the moment, we read in the newspaper, there is no defense against the Intercontinental Ballistic Missile, although the Army is doing research on the possibility of an antimissile missile. Are we stuttering? No, just staggering. The I.C.B.M., when operational, will be able to carry a hydrogen warhead a distance of 5000 miles through the stratosphere in about thirty minutes.



WHISTLING ON THE WIRE?—No, the attractive young lady is blowing gently on a test specimen of wire, while the appreciative young man is registering her breath in the series of dots on the glass behind her, to demonstrate a Dilatometer at Northrop Aircraft, Inc., Hawthorne, Calif. The machine, combining photographic equipment and an electronic furnace capable of heating specimens to 2000 degrees F., is one of the few in this country. It determines even the most infinite coefficients of expansion of metals under heat, useful in probing thermal barriers.



Specialties, Inc.

2635 WEST MEDILL AVENUE
CHICAGO 47, ILLINOIS

SPURS - SPIRALS - HELICALS - REVELS - INTERNALS
WORD GRAING - BACKES - THEAD GRINDING

OF RACITOMAL HORSPFOWER GLARIES
OF RACITOMAL HORSPFOWER GLARIES

Top precision in the G. S. 5 and 8 thread hardened and ground Worms pictured above, is consistently maintained on G. S. precision equipment. Accuracy and uniformity of lead, and thread spacing accuracy, of vital importance in precision multiple Worms, is under the strict control of highly skilled workmen. The 4 thread Worm has hobbed threads, case hardened and polished. This method is more economical and a great degree of accuracy is maintained through G. S. specialized heat treating. The 3 thread Worm is hobbed and brushed. This most

economical method is recommended for unhardened multiple thread Worms. The single thread Worm is precision ground from the solid, on a heat treated shaft. *\pi\$ G. S. men, methods and machines are developed to produce a degree of accuracy, efficiency and economy that will cut costs and improve product performance for you. Modern equipment and extensive inspection facilities assure absolute control of quality. Customer furnished blanks or a complete job, optional. Send drawings or details, today.

41 Years of Specializing in Small Gearing!

MOUSTRY

California

Contracts have been signed for the sale of HUFFORD MACHINE WORKS, INC., El Segundo, Calif., to the Pacific Industries, Inc., with headquarters in San Jose, Calif. Merrill L. Bengston will continue as president of Hufford but has now also been named a director of Pacific Industries and chairman of the executive committee. No changes in Hufford personnel or management are contemplated.

CHARLES N. PERRY, purchasing agent for Rockwell Mfg. Co.'s Oakland, Calif., plant for the past five years, has been named factory manager of the company's new Porterville, Calif., plant.

Georgia, Florida and Tennessee

Southern Tool Distributing Co., Atlanta, Ga., has been appointed sales representative for the Taft-Peirce Mfg. Co., Woonsocket, R. I., and will handle Taft-Peirce instruments, gages, fixed gages, magnetic chucks, and toolroom equipment throughout Georgia and northern Florida.

HARRY P. LEU, INC., 100 W. Livingston Ave., Orlando, Fla., has been appointed sales representative for the Taft-Peirce Mfg. Co., Woonsocket, R. I. and will cover the entire state of Florida outside the northwestern area.

Noland Co., Inc., Chattanooga, Tenn., has been appointed distributor for Niagara Machine & Tool Works, Buffalo, N. Y., in Georgia and Tennessee. The company will distribute Niagara's entire line of presses, press brakes, shears, and related machines and tools.

Illinois

Joseph T. Ryerson & Son, Inc., Chicago, Ill., announces the following appointments: H. Daniel Robb has been promoted to national product manager, alloy steels, with headquarters in the company's gen-





(Left) H. Daniel Robb, national product manager, alloy steels; and Clive C. Earle, sales manager of the Buffalo plant of Joseph T. Ryerson & Son, Inc.

eral offices in Chicago. CLIVE C. EARLE has been appointed sales manager for the company's Buffalo plant. James E. Burke has been appointed manager of alloy and stainless steel sales in the Pittsburgh Steel Service plant. WILLIAM I. WALLER has become manager of the work order department, while RICH-ARD T. ROLLISON has taken over the post of manager of the reinforcing steel products department, at Wallingford, Conn. MILTON C. FIDGEON was named assistant sales manager of the New York area steel service plant located in Jersey City, N. J. HARRY A. ZAHN has been appointed manager of alloy steel sales at the Philadelphia steel service plant.

CHICAGO-LATROBE TWIST DRILL WORKS, Chicago, Ill., announces the following sales appointments: Herbert A. Dartsch has been named sales representative for the Chicago territory; James F. Marshall will cover Detroit, Mich., area as salesman; and Everett E. Slittor will represent the company in the southern Ohio territory.

Andrew L. Pontius has been elected a vice-president of the Illinois Tool Works, Chicago, Ill. Mr. Pontius joined the company in 1952 and was made general manager of

the company's Shakeproof Division in 1955.

E. C. Westphal has been named an assistant sales manager at Rolled Steel Corporation, Skokie, Ill. He has been with the company since 1953.

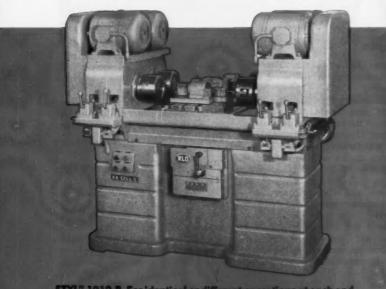
E. C. Wilson has been elected vice-president of the Illinois Gear & Machine Co., Chicago, Ill. Mr. Wilson has been associated with the company since 1942.



E. C. Wilson, vice-president, Illinois Gear & Machine Co.

Maximum Production Speeds at Low Cost

WITH EX-CELL-O
PRECISION BORING MACHINES



STYLE 1212-B. For identical or different operations at each end.
When loading time of parts approximates the time of machining, a double-end machine practically doubles production.

These versatile Ex-Cell-O Precision Boring Machines bore, turn, face, counterbore, chamfer and groove.

Whichever model fits your production requirements, you'll find this large variety of precision operations will lower your costs—increase your profits.

All Standard Ex-Cell-O Precision Boring Machines can be equipped for work handling and ejecting operations, thus providing fast, automatic production at minimum cost.

Contact your local Ex-Cell-O representative who will provide all the facts about these machines, or write to Ex-Cell-O for a precision boring catalog.



EX-CELL-O FOR PRECISION



STYLE 2112-B. Single-end model for work pieces in the small and medium-size range. Flexible hydraulic controls give easy adjustment of work cycle.



STYLE 112-D. Large and sturdy with long stroke. Accommodates medium and heavy work, gives maximum precision production, minimum operating cost.



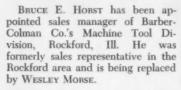
STYLE 17-A. Massive construction. Maintains the highest precision standards on a profitable production basis. Economical in operation, can be tooled for a wide range of production jobs.

EX-CELL-O CORPORATION DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS . GRINDING SPINDLES . CUTTING TOOLS . RAILROAD PINS AND BUSHINGS . AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS . DAIRY EQUIPMENT



Bruce E. Horst, sales manager, Machine Tool Division, Barber-Colman Co.



JOSEPH R. SMITH has been appointed western district manager for Flick-Reedy Corporation, Melrose Park, Ill. Mr. Smith will be responsible for sales in all states west of the Mississippi River for the firm's two divisions.

O. E. MARTHINSON has been elected vice-president in charge of Eastern sales for Graymills Corporation, Chicago, Ill. Mr. Marthinson, who opened the first Eastern sales office for Graymills, has been with the company since 1941 and will maintain headquarters for sales operations in Allentown.



F. A. De Christopher Studios

O. E. Marthinson, vice-president of Eastern sales for the Graymills Corporation



(Left) F. V. Gieryn, sales manager, industrial department; and Russell Dupuis, manufacturing manager, Machinery Hydraulics Division, Vickers Incorporated

Michigan

VICKERS INCORPORATED, Detroit, Mich., announces the following appointments: F. V. GIERYN was named sales manager, industrial department; and Russell Dupuis has been made manufacturing manager, Machinery Hydraulics Division. Mr. Gieryn was formerly manager of export sales. In his new capacity, he will supervise sales of the company's hydraulic units and systems for machine tools and other plant production machinery through twenty industrial sales offices throughout the United States. Mr. Dupuis will manage machinery hydraulies production in the Machinery Hydraulic's Div.sion's plants at Omaha, Neb.; Waterbury, Conn.; and El Segundo, Calif. At the same time it was announced that Rob-ERT A. ERSKINE has been appointed chief engineer, industrial department, Detroit, Mich.

ROBERT N. KENDALL has been appointed vice-president of Colonial Broach & Machine Co., Detroit, Mich. Mr. Kendall, who has served as sales research consultant with headquarters in Washington, D. C., was for many years sales engineer for Colonial in the Detroit area. He will continue to make his headquarters in Washington.

Turchan Follower Machine Co., formerly of Detroit, has moved into new buildings at 26950 Van Born Road, Inkster, Mich. The new plant provides 20,000 square feet of floor space to accommodate greatly increased engineering, experimental, and manufacturing facilities.

RIORDAN MACHINERY Co., Detroit, Mich., has been appointed repre-

sentative for the Chambersburg Engineering Co., Chambersburg, Pa., in the eastern Michigan, Toledo, and Fort Wayne areas.

W. A. Johnson has been appointed sales manager of the Grinder Division, Royal Oak Tool & Machine Co., Royal Oak, Mich.

New England

WILLIAM H. McManus, hoist sales executive for Yale Materials Handling Division, Yale & Towne Mfg. Co., has been appointed New England hoist district sales manager. Mr. McManus, who will make his headquarters in Boston, replaces ROGER R. REYNOLDS who has been transferred to the Texas, Oklahoma, and Louisiana sales territory.

L. S. STARRETT Co., Athol, Mass., announces the appointment of four salesmen in the following areas: RICHARD H. CHACE, San Francisco, Calif., CHARLES B. WHIPPS, TOronto, Ontario, Canada; ALLAN B. CARNUTH, Atlanta, Ga.; and ROBERT J. CARNEY, Los Angeles, Calif.

CHARLES W. MOORE has been appointed representative for the S. W. Card Division of Union Twist Drill Co., Athol, Mass., for West Virginia, western Ohio, and a part of Kentucky.

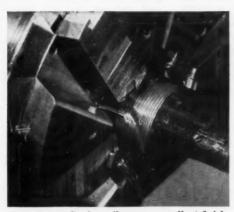
Bryan W. Moylan has been appointed sales engineering representative for the Hydraulics Products Division of Brown & Sharpe Mfg. Co., Providence, R. I. He will be responsible for the development of markets for the company's hydraulic products along the Eastern seaboard of the United States.

(This section continued on page 266)



For precision cutting...

TRANSPARENT SUNICUT OILS ASSURE YOU GOOD VISIBILITY, PEAK PRODUCTION



Transparent Sunicut oils assure excellent finish in critical operations at close tolerances. Good visibility speeds production.

Transparent Sunicut® oils, including heavy-duty and dual-purpose oils, are available in many grades to suit your specific needs. They give outstanding results...especially where precision cutting is required.

Their transparency takes the "blinders" from work that needs close watching, permitting close product control, faster production, lower unit cost. Machine operators like Sunicut's "cleanliness." Most important, transparent Sunicut oils assure you of good finishes.

For full information about Sunicut cutting oils, call your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. M-7.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

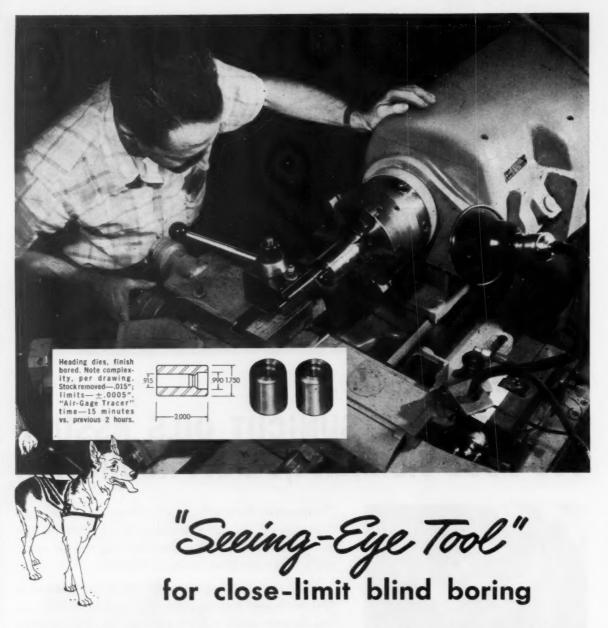
Philadelphia 3, Pa.

In Canada: Sun Oil Company Limited, Toronto and Montreal



For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-257



Want to take the guesswork out of close-limit blind boring? And with it that unhappy combination of low production and high spoilage? How? Let the Monarch "Air-Gage Tracer" be your lathe operator's seeing-eye.

With this device you're as certain of meeting tolerances in boring as in turning or facing. Your template is precise. Your tracer stylus, operating on a pressure of only 5-6 ozs., converts changes in template contour to corresponding tool positions within a few thousandths of a second. You hold size with certainty piece after piece—the template sees to that. Up goes production anywhere from 10 to 90%, accuracy and

finish are improved—all accomplished with the most accurate duplicating device yet designed.

The "Air-Gage Tracer" can be factory-applied to most Monarch lathes. Prove your vision by requesting full information in the form of our complete booklet No. 2608...... The Monarch Machine Tool Company, Sidney, Ohio.



FOR A BETTER TURN FASTER . . . TURN TO MONARCH

Use postage-free Business Reply Cards for further information On New Catalogues described in this issue of MACHINERY On New Shop Equipment described in the editorial pages On products shown in the advertisements

NEW CATALOGUES

CORROSION-RESISTANT ALLOYS — Haynes Stellite Co., Division of Union Carbide Corporation, New York City. 104-page booklet entitled "Hastalloy Corrosion-Resistant Alloys," giving upto-date information on four nickel-base alloys—Hastalloy alloys B, C, D, and F. Described are chemical compositions, physical, mechanical, and high-temperature properties. Also included is a table of the comparative resistances of these alloys to over 250 corrosives commonly handled in the chemical, petroleum, paper and pulp, pharmaceutical, and metalworking industries. A separate section describes techniques for forging, cold-working, machining, grinding, and welding. Copies can be obtained from the Advertising Department, Haynes Stellite Co., Division of Union Carbide Corporation, 420 Lexington Ave., New York 17, N. Y.

ABRASION-RESISTING STEEL—Joseph T. Ryerson & Son, Inc., Chicago, Ill. Revised bulletin describing a specially balanced composition for hardness and ductility, supplied in sheet and plate form for structures and equipment subjected to abrasion. This product is said to give from two to ten times longer service than ordinary low-carbon steel, exceed some of the higher carbon steels in wear resistance, and compare favorably in service with more costly rolled and cast alloys. Included is information on fabrication and heat-treatment.

SHEAR KNIFE HANDBOOK—American Shear Knife Co., Homestead, Pa. Ringbound handbook giving in detail the grades of shear knives available, Information for selecting the correct grade SINGLE-PHASE INDUCTION MOTORS—General Electric Co., Schenectady, N. Y. Bulletin GEC-1419, describing the company's Tri-Clad, 55, single-phase induction motors from 3/4 to 5 hp; frames 182, 184, 213, 215; 115 to 230 volts; 60 cycles. Application data, types, rotings, frame sizes, and construction features of drip-proof and enclosed single-phase induction motors are given.

METAL-SHEARING AIDS—Hill Acme Co., Cleveland, Ohio, Ring-bound folder covering various types, sizes, and grades of Cleveland metal-cutting knives best suited to all types of metal shearing. Slitters, squaring blades, alligator, and bar knives are included. Care and handling, best cutting practice, and recomended grades for various operations are included, together with specifications. . . 6

WELDING BLOWPIPES—Linde Company, Division of Union Carbide Corporation, New York City. Illustrated folder describing three Oxweld welding blowpipes. Operation on low-pressure acetylene is the unique feature of the three blowpipes described. Low-pressure operation makes it possible to work these blowpipes at acetylene pressures less than I psi, which is far below pressure requirements of ordinary 3 pwpipes, ... 7

HYDRAULIC POWER UNITS—Oil-Dyne, Inc., Chicago, III. 52-page catalogue describing hydraulic power units including pumps, cylinders, pressure switches, and accessories. Complete technical data and specifications are given on 2240 different types and models; single- and duplex-pressure switches; hydraulic cylinders; and a full line of accessories, including tube connectors, valves, hydraulic hose and fittings, and tubing and gages.

STAINLESS-STEEL SHEET AND STRIP— Allegheny Ludlum Steel Co., Pittsburgh, Pa. 32-page booklet containing information on stainless-steel sheet and strip.

> FIRST CLASS Permit No. 53 (Sec. 34.9, P.L. & R.) New York, N. Y.

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NUMERICAL POSITIONING CONTROL—General Electric Co., Specialty Control Department, Waynesboro, Va. Bulletin GET-2675, describing the functions of numerical positioning control and giving a detailed breakdown of the three major elements—data input, director, and servo drive. Features are illustrated, and each operation is graphically shown.

GRINDING-WHEEL DRESSER—Threadwell Tap & Die Co., Greenfield, Mass. 4-page folder describing the company's Tangi-Matic dresser. Detailed explana-

tion of operation is given, along with specifications and special features of the machine that will do precision dressing of grinding wheels to any desired form faster than by conventional methods, ...13

CONTROLLED-VOLUME PUMPS—Milton Roy Co., Philadelphia, Pa. Bulletin 553-1, describing the company's complete line of motor-driven, controlled-volume pumps. Complete specifications and latest design data on these positive displacement pumps are included. Standard and modified models and their applications are illustrated and described. 14

BROACHING TOOLS—LaPointe Machine Tool Co., Hudson, Mass. 24-page booklet entitled "How to Care for Broaching Tools," giving hints on the handling of broaching tools while in use on the machines, when being resharpened, and during transfer in the shop from one department to another. Close-up photographs and cartoons illustrate the various points.

CONTROL VALVES—C. B. Hunt & Son, Inc., Salem, Ohio. 12-page bulletin describing the company's "Quick-As-Wink" air and hydraulic control valves, including MOTORS AND DRIVES—Reliance Electric & Engineering Co., Cleveland, Ohio. 8-page booklet entitled "The Moving Force of Industry," describing the company's complete line of alternating- and direct-current motors, gear-motors, motor-generator sets, motor controls, and completely packaged mechanical and electronic adjustable-speed drives. 18

COLD-ROLLED SPRING STEELS—Sandvik Steel, Inc., Fair Lawn, N. J. Illustrated bulletin describing the company's spring and specialty strip steels, including specification information on some of the leading types of strip steels. Each type is illustrated by application, and the material, finish, usual size range, and chemical analysis in per cent is given for each. 21

POSITIVE-INDEX TABLE — Colonial Broach & Machine Co., Detroit, Mich. Bulletin JF-57, describing the design, operation, and application of the company's positive-index table. The universal table uses a no-backlash gear mechanism to provide high-precision indexing control.23

Product Information Service

Use postage-free Business Reply Card below for further information on New Catalogues or New Shop Equipment described in this issue and products mentioned in the advertisements.

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ELECTROLIZING PROCESS—Electrolizing Corporation, Chicago Heights, III. 24-page catalogue autlining how electrolizing overcomes friction, wear, abrasion, galling, and fretting corrosion problems, and at the same time increases mechanical reliability.

LUBRICANTS—Alpha Molykote Corporation, Stamford, Conn. 16-page bulletin entitled "Breaking Lubrication Barriers," giving details on the development of the company's line of molybdenum disulfide lubricants. Covered are the physical and mechanical properties of the compound.

POWER TRANSMISSION EQUIPMENT— Clark Equipment Co's Transmission Division, Jackson, Mich. 12-page booklet describing the company's synchronous transmission series, StepMatic transmissions, TransVerters, and torque converters ranging from 11 to 26 inches in size. . . . 31

FLEXIBLE ACTUATOR SWITCH—Micro Switch, a Division of Minneopolis-Honeywell Regulator Co., Freeport, III. Data sheet 113, describing and illustrating the company's flexible actuator switch. . . 35

COUPLING—Snap-Tite, Inc., Union City, Pa. Bulletin 270, describing the company's quick-connect, quick-disconnect HK coupling, which will handle acids, alkalies, solvents, and high-pressure steam. 36

STAMPING PRESSES—Alpha Press & Machine, Inc., Detroit, Mich, Catalogue 57-2, describing the company's two-point, back-gear underdrive, high-speed, automatic, production stamping presses. . . 37

TORQUE TESTING FIXTURES—P. A. Sturtevant Co., Addison, III. Illustrated folder describing the company's torque testing fixtures. Typical applications are illustrated, and brief explanations are

PROFILER—Arrow Engineering Co., Inc., Indianapolis, Ind. Bulletin PR-156, describing high-speed contouring, pocketing, and swarf cutting of aluminum, titanium, and steel with the company's profiler.

HONING TOOLS — Barnes Drill Co., Rockford, III. Bulletin 570, describing the company's BarnesdriL honing tool designed for individual job and shop requirements.

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SUBSCRIPTION DEPT.



PACKAGED FITTINGS — W-S Fittings Division, H. K. Porter Co., Inc., Roselle, N. J. 4-page bulletin presenting complete data on a new packaging concept for W-S forged steel pipe fittings. Included are the quantities of each type and size of each fitting packaged in the various sizes of cartons, the dimensions of each carton, and the weights of the packaged quantities of each fitting. 45

SINGLE - SPINDLE AUTOMATICS — Cleveland Automatic Machine Co., Cincinnati, Ohio. Bulletin describing the company's Model B automatic which comes in 1 5/8 and 2 1/2 inches. These machines are well suited for producing TOOLS AND DIES—Jaquith Carbide Division of Pratt & Whitney Co., Lynn, Mass. Illustrated catalogue describing the company's carbide tools and dies. . . . 48

SURFACE GRINDER—Covel Mfg. Co., Benton Harbor, Mich. Bulletin 177, describing the company's No. 17, 10- by 16-inch hand-feed surface grinder. . . 49

BELLOWS — Belfab Corporation, Agawam, Mass. Illustrated catalogue covering the company's welded bellows in stainless steel and similar alloys. . . . 51

SHELL MOLDING—Dow Corning Corporation, Midland, Mich. Folder describling the shell-molding process with the company's silicone parting agents. . . 54

SPECIAL ASSEMBLY MACHINES—Omer E. Robbins Co., Detroit, Mich. Illustrated folder describing the company's Assemblimatic special assembly machines. 58

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Boosts Production of Rear Band Servos

This new OLOFSSON Special, Three Station, Two
Way Precision Boring Machine performs multiple
operations on rear band servos in the plant of
a leading automobile manufacturer.

In the three stations shown at right, the machine rough bores, forms angle, grooves, and finish bores.

Production is 220 pieces per hour.



For "Profit-Making" Special Machinery designed to lower your production costs, consult OLOFSSON. You'll find it pays! Phone IV anhoe 4-5381, or write...

LOFSSON CORPORATION 2729 Lyons Avenue Lansing, Michigan

Manufacturers of PRECISION BORING MACHINERY AND SPECIAL MACHINERY



STATION 1



Rough bore, form angle, and greave.



STATION 3 Finish bore.

DoALL Sets New Industry Standards for Gage Blocks...and Reduces Prices

COMPARISON OF DOALL GAGE BLOCK STANDARDS WITH NATIONAL BUREAU OF STANDARDS CRITERIA AS OF FEB. 1, 1957.

GRADE		LENGTH		FLATNESS		PARALLELISM		SURFACE FINISH		HARDNESS		GENERAL
DoALL	BUREAU	DeALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	
AAA	None	+.000001"	None	.000001"	None	.000001"	None	0 to 0.09 AA	None	66 Rc	None	Finest blocks manufactured commercially
AA	AA	+.000002° 000002°	+.000002° 000002°	.000002*	.000002"	.000002*	.000002*	0 to 0.09 AA	0.5 AA	66 Rc	65 Rc	Most accurately calibrated AA Blocks available
A+	None	+.000004" 000002"	None	.000004"	None	.000004"	None	0 to 0.09 AA	None	66 Rc	None	A+ Grade for the price of B
A	A	+.000006° 000002°	+.000006° 000002°	.000004*	.000004*	.000004*	.000004*	.8 AA	.8 AA	65 Rc	65 Rc	New low priced "working" SHOP-BLOCKS
None	8	None	+.000010° 000006°	None	.000006*	None	.000006*	None	1.2 AA	None	65 Rc	Not recommended for today's tolerances



Here is What Has Been Done:

- B Grade blocks discontinued on the basis of their inadequacy for controlling modern tolerances.
- New AAA Grade (± .000001") established for ultra-precision control.
- AA Grade (± .000002") reduced in price as much as 70%, permitting wide usage for routine inspection work.
- New A+ Grade (+ .000004", 000002") established for inspection and shop use, and offered at B grade prices.
- New optical surface finish of 0 to 0.09 arithmetical average for AAA, AA and A+ blocks, permitting more accurate calibration and lengthening block life.
- New A Grade "working" SHOP-BLOCKS established and offered at B grade "working" block prices!

Better Blocks for Better Control

Completely new gage block standards have been established by The DoALL Company after a comprehensive appraisal of modern measurement needs.

With .001" a common tolerance today, B grade blocks no longer provide adequate dimensional control of working gages in the shop. And when parts tolerances of 100, 75, 50 and 25 millionths are specified, the need for blocks of greater accuracy becomes apparent immediately.

To meet these conditions . . . to reduce costs, rejects and waste . . . DoALL has upgraded its entire gage block line as shown at the left and in the table above. At the same time new manufacturing techniques and increased production have made possible major price reductions. For example, you get A+ grade blocks for the price of B.

Note that B grade blocks have been completely discontinued. Even the new DoALL SHOP-BLOCKS are A grade . . . available at the price of B "working" blocks.

DoAll now offers you the most accurate line of gage blocks in the world. They provide finer, lower cost dimensional quality control than has ever before been available. Why not take advantage of it . . . at no premium in price. Call DoALL locally or write today.

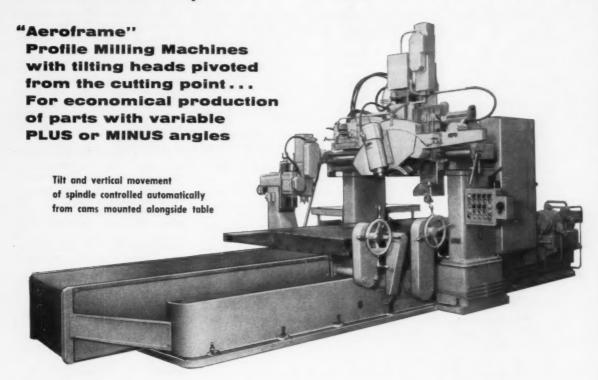
ASK FOR LITERATURE



Des Plaines, Illinois



MOREY for PROFIGING



MOREY SOM HEAVY DUTY "AEROFRAME" PROFILE MILLING MACHINE

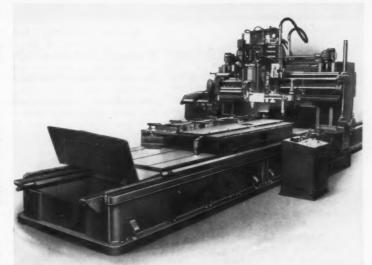
Available with rise and fall, and tilt motion automatically controlled from template mounted on side of machine. The Morey 50M can be supplied in any width to suit your requirements.

MOREY SOCMA COMBINATION SKIN MILLER AND TRACING MACHINE

Motor 100 HP at 3600 RPM; automatic 360° tracing; automatic remote control vertical positioning; table 6' x 20'; equipped with right angle horizontal attachment (not shown in photograph at right).

Similar machines are available in both hand or automatic control, including the automatic control of the vertical head pivoted from the point of the cutter 20° plus or minus.

These machines will solve your difficult problems with ease—For completely detailed information, write now to Dept. M-7.



MOREY MACHINERY CO., INC.

Manufacturers and Distributors of Fine Machine Tools

383 LAFAYETTE STREET, NEW YORK 3, N. Y.
ALGONQUIN 4-6560 • CABLE ADDRESS: WOODWORK, N. Y.

BUILDERS OF AUTOMATIC LATHES - AUTOMATIC TRANSFER EQUIPMENT - VERTICAL SHAPERS - TURRET LATHES

JOHN H. WRIGHT has been appointed field engineer for the Nelco Tool Co., Manchester, Conn. In his new position, Mr. Wright will perform sales liaison between the carbide tool user, the distributor, and Nelco plants in Manchester and Berlin, Conn.

James W. Caswell has been appointed Southeastern representative for the Socket Screw Division of Bristol Co., Waterbury, Conn. Mr. Caswell will make his headquarters at 216 Healey Bldg., Atlanta, Ga.

R. W. Selvic has been appointed sales representative for the New York and New Jersey territories for Helicoid Gage Division, American Chain & Cable Co., Inc., Bridgeport, Conn.

Chagnon Co., 70 Mack St., Windsor, Conn., has been appointed representative in the Connecticut and New England areas for the Instrument Division of Engis Equipment Co., Chicago, Ill.

New York and New Jersey

ACF Industries, Inc., New York City, has combined its Nuclear Energy Products and Erco Divisions. Headquarters of Nuclear Products-Erco will be at the Erco plant in Riverdale, Md., near Washington, D. C. Erco-formerly Engineering & Research Corporation—was acquired by ACF in 1954.

OSCAR B. SCHIER, II, has been designated secretary-elect of the American Society of Mechanical Engineers, New York City. He will succeed CLARENCE E. DAVIES, who will retire as secretary after twenty-three years of service.

FRED L. PLUMMER has been appointed national secretary of the American Welding Society. He will assume his new duties immediately and will maintain his office at the Society's national headquarters in New York City.

MASERATI CORPORATION OF AMERICA has moved to new and larger quarters at 46 Sea Cliff Ave., Glen Cove, Long Island, N. Y.

W. GERALD LANTERMAN has been named manager of sales, Industrial Division, Lamson Corporation, Syracuse, N. Y.

PANGBORN CORPORATION, Hagerstown, Md., announces that its New York City office has moved to 4

Franklin Bldg., 1025 Broad St., Newark, N. J.

Ohio

SHEFFIELD CORPORATION, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation, announces the following appointments: O. A. AHLERS, senior vice-president, has been given the over-all direction of the Machine Tool, Contract Manufacturing, and Threadwell-Conway Tap & Die Product Divisions. W. FAY ALLER, previously vice-president of the Autometrology Division, is appointed vice-president to supervise and coordinate the company's Autometrology, Standard Production Instruments, and Fixed Gage and Inspection Instruments Divisions. J. T. Welch, who has previously served as general manager of the Machine Tool Division, is named assistant vice-president for coordinating the operations of the company's national field sales organizations. WILLIAM I. WILT, formerly general manager of the Standard Production Instruments Division, has been advanced to assistant vice-president of this division.

JOHN F. CACHAT has been appointed works manager of the Ohio Crankshaft Tocco Division, Cleve-Iand, Ohio. In his new capacity, Mr. Cachat will head Tocco's engineering and manufacturing activities.

EUGENE CALDWELL has been elected president of the Baker-Raulang Co., Cleveland, Ohio. He was formerly vice-president and general manager of the Hyster Co., Portland, Ore. Mr. Caldwell succeeds PERCY L. DOUGLAS who con-

tinues as a director of the company and executive vice-president of Baker's parent Company, Otis Elevator Co.

RALPH L. BOYER has been elected vice-president and director of engineering, Cooper-Bessemer Corporation, Mount Vernon, Ohio.

R. L. WILLIAMS has been appointed assistant chief engineer, Automotive Division, Timken Roller Bearing Co., Canton, Ohio.

Pennsylvania

JOHN H. DIEHL has been named assistant to the vice-president in charge of the Power Tool Division, Rockwell, Mfg. Co. He was formerly assistant works manager of Allis-Chalmers Mfg. Co., La Porte, Ind., works. He will make his head-quarters temporarily at Rockwell's power tool plant in Bellefontaine, Ohio, before moving to Pittsburgh.

BALDWIN-LIMA-HAMILTON CORPORATION, Philadelphia, Pa., announces the following appointments: Perry A. White, general controller, has been appointed vice-president and general manager of the Eddystone Division, Eddystone, Pa. At the same time it was announced that Robert G. Tabors, vice-president and assistant general manager of the corporation's Hamilton Division, was named vice-president and general manager of the Electronics and Instrumentation Division, Waltham, Mass. Succeeding Mr. White as general controller is Robert P. Bauer, who has been controller at B-L-H, Lima, Ohio.

(This section continued on page 270)





(Left) Perry A. White, vice-president and general manager, Eddystone Division; and Robert G. Tabors, vice-president and general manager, Electronics and Instrumentation Division, Baldwin-Lima-Hamilton Corporation

No Diamonds Needed!



Ex-Cell-O Method X Tool Sharpener Cuts Carbides Without Expensive Wheels

Compare the cost! Diamond wheel cost in off-hand tool grinding runs eight to twelve dollars per cubic inch of carbide removed. Wheel expense with Method X averages only 20 cents.

Compare the work! Method X produces no thermal stresses—won't chip or score carbide tips. Both carbide and shank are removed simultaneously—no need grinding secondary clearances.

Compare the operation! Operators can handle Method X Machines without special training. No pressure on the workpiece means less operator fatigue. Cutting speed (comparable to diamond wheel grinding) and desired matte finish—simply a matter of setting a power selector switch.

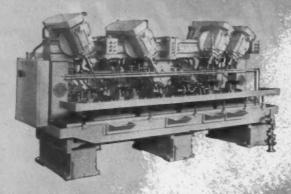
For full information on Method X send today for your copy of Ex-Cell-O's illustrated Bulletin #43272. Or ask your local Ex-Cell-O Representative for one.

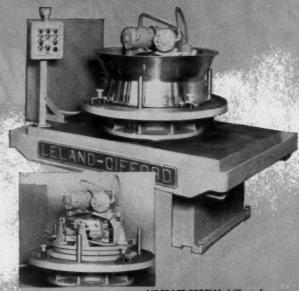


MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

57-40

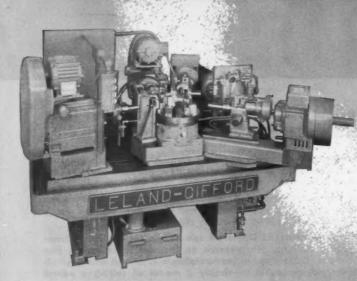
CRANKSHAFT OIL HOLE drilling machine. Four stations with self-contained units rail mounted for maximum flexibility of arrangement. Manually loaded with automatic clamping and release. Drills eight deep oil holes at 20 shafts per hour.



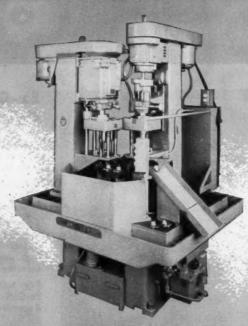


AIRCRAFT SPECIAL drills and reams 70 radial holes in a jet engine turbine case weldment at 3 pieces per hour. Insert shows tooling.

LELAND-GIFFORD



FUEL PUMP BODIES are drilled ($\frac{1}{2}/4u'' \times 1.54''$) and tapped ($\frac{1}{4}$ -18) two holes each at 240 pieces per hour. Four self-contained units operate around a three-station indexing fixture.



1400 PIECES PER HOUR. Suspension part dust caps are loaded two at a time in a four-station indexing fixture, drilled and tapped for a grease fitting, automatically ejected to chute and conveyor.



NEW HOLE LOCATOR for fast, accurate, jigless drilling with optical positioning from a simple, reusable layout chart.



INDUSTRY'S STANDARD for precision drilling and tapping. No. 2LMS is available in one to six spindles; 20" or 26" swing; speeds up to 3600.RPM; hand, power or hydraulic feed.



FOR HEAVY DUTY DRILLING, No. 3MVB is available with eight speeds up to 1800 RPM; 24" swing; one to four spindles; hand, power or hydraulic feed.

TOOLROOM DRILL PRESS. No. 2LMS has 26" swing, oversize table, eight speeds, reversing motor for tapping. No. 3MVB with extra capacity also



Drilling Machines

Representing more than 50 years of specialization in the manufacture of precision drilling equipment, the Leland-Gifford line includes:

STANDARD sensitive and hydraulic feed machines in a complete range of types and sizes including the Leland-Gifford Hole Locator for jigless drilling with optical positioning.

SPECIAL machines incorporating Leland-Gifford drilling units, multiple heads, indexing tables, quick-handling fixtures and other high production features.

Bulletins give complete information. Write for them . . . or contact the office near you.



SELF-CONTAINED UNITS. Four sizes for holes from .020" to 1.500". Furnished with motor, hydraulic pump and accumulator system; dual feed, step x step or plain feed.



LELAND-GIFFORD COMPANY

WORCESTER 1, MASSACHUSETTS

Branch Offices... CHICAGO 5, 2515 W. Peterson Age. • CLEVELAND 22, P. O. Box 853 • DETROIT 21, 10429 W. McNichols Rd. • INDIANAPOLIS 6, P. O. Box 1051 LOS ANGELES, 2620 Leonis Blvd., Vernon 58, Cal. • NEW YORK, 75 S. Orange Ave., South Orange, N. J. • ROCHESTER 12, P. O. Box 24, Charlotte Station,



James S. Anderson, vice-president, Tubular Products Division of the Babcock & Wilcox Co.

James S. Anderson, formerly general sales manager of Tubular Products Division of Babcock & Wilcox Co., has been elected vice-president of the company in charge of sales for that division. Mr. Anderson will continue to make his head-quarters in Beaver Falls, Pa. He joined the company in 1941 as a district salesman in the Division's New York office; was named assistant manager of that office the next year; and assistant general manager in 1948. He was promoted to sales manager in 1953.



William B. Downes, manager of Stainless Steel Division, Crucible Steel Company of America

WILLIAM B. Downes has been appointed manager, Stainless Steel Sales Division, for the Crucible Steel Company of America, Pitts-

burgh, Pa. Mr. Downes has been assistant division manager for stainless steel sales for more than two years. In his new capacity, he will maintain over-all responsibility for sales of stainless steel products. He has been with the company for almost twenty-three years.

Dr. Walter A. Dean has been named assistant development metallurgist for the Aluminum Company of America, Pittsburgh, Pa.

JOHN R. ONDERS has been named sales engineer for Wall Colmonoy Corporation Co.'s Pittsburgh, Pa., office.

Obituaries

Joseph B. Armitage, consultant vice-president at Kearney & Trecker, Milwaukee, Wis., since 1955, died on May 30 at the age of seventy-six years. Mr. Armitage joined the company in 1920 as chief engineer and held this position until 1943 when he was elected vice-president in charge of engineering. During his thirty-seven years with the company, he was credited with 121 patents in the machine tool field.

He was a member and director at large of the American Society of Mechanical Engineers, and in 1955, was named honorary member of that organization which carried with it a lifetime membership. He was past chairman of the Society of American Engineers, Milwaukee section, as well as a director and member of the Milwaukee Engineering Society, and held a membership in the Newcomen Society, a group devoted to the study of material history.



Joseph B. Armitage

SIR ALFRED HERBERT, K.B.E. chairman and managing director of Alfred Herbert Ltd., Coventry, England, died on May 26th at the age of ninety years. In 1894, his company was formed and Herbert machine tools soon gained acceptance in a wide field. For more than sixty years, under the guidance of Sir Alfred, the firm continued to grow in size and importance and has made many outstanding contributions to the machine tool industry. In addition to the work he did in developing his own company, Sir Alfred played an active part in furthering the growth and prestige of the machine tool industry in general.

Correct Address

In an item published in April Machinery, mention was made of "Erie Forge & Steel Corporation's Buffalo plant." The headquarters of this concern are in Erie, Pa., where it has been producing steel forgings and castings since 1872.

Coming Event

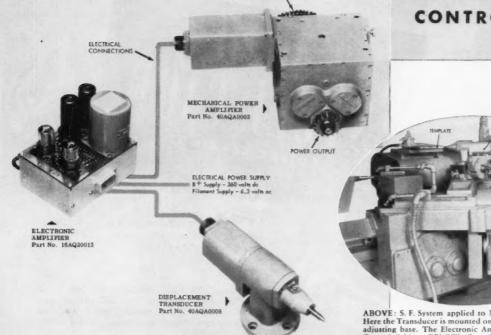
JULY 29-AUGUST 2—Annual Sales Conferences of Sales Executives, Advertising Managers, and Sales Engineers of member companies of the NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION and the AMERICAN TOOL DISTRIBUTORS' ASSOCIATION to be held at Cornell University, Ithaca, N. Y. For further information contact Hill & Knowlton, 323 Republic Building, Cleveland 15, Ohio.

Safety Awards to Tool and Die Shops

The National Tool & Die Manufacturers Association has presented awards to 288 member plants for outstanding safety records compiled in 1956. In the second annual Safety Contest held by the group, 260 members earned a Gold Award for having an accident frequency rate of less than 60 per cent of the average for the contract tool and die industry in 1956. Of these plants, 244 had an accident-free year. An additional 28 members won a Silver Award for showing an improvement over their 1955 frequency rate.

PERFORMANCE ASSURED WITH SENECA FALLS

ELECTRO-MECHANICAL
CONTROLS



ABOVE: S. F. System applied to Model AP Tracer Lathe. Here the Transducer is mounted on a universal, micrometer adjusting base. The Electronic Amplifer is housed in the Control Cabinet. BELOW: Overall view of same machine.

▶ This patented Seneca Falls System, now available to industry, consists of a Displacement Transducer having built-in switches for sensing both initial actuation and overtravel of the stylus; an Electronic Amplifier; and a Mechanical Power Amplifier providing up to one H. P. of control output. The Power Amplifier takes its power from a constantly revolving shaft and drives the load in accordance with the original sensing signal. The system will reposition within ±.0002″ and can be used for both single and two dimension control.

This Displacement Transducer may be replaced by any standard AC signal source for controlling the Mechanical Power Amplifier. Such source can provide for manual or automatic control from process control transducers, velocity transducers or computer systems.



BELOW: Seneca Falls Model Q Tracer Lathe with four carriages controlled by the S. F. System.



Write for technical data, preferably with full information about your control problem.



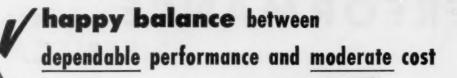
MACHINE TOOLS SINCE 1864

SENECA FALLS MACHINE CO.

Seneca Falls, New York

Automatic and Semi-automatic Lathes • Automatic Drilling and Centering Machines

Automatic Work Drivers • Production Tracer Lathes • Automation and Work Handling Devices • Special Production Machinery





Tru-Rol precision, steel-cage, beavy-duty bearing with contoured guide lips assuring true right-line rolling, maintained roller alignment and thin oil film.

■ Rollway's TRU-ROL Steel-Cage Bearings afford wide latitude in balancing dependable performance, long life, and bigb load capacity against moderate cost. They rate high in any comparison on a costperformance basis.

A choice of stamped steel retainers with contoured guide lips, or steel segmented retainers assure true rolling and an evenly distributed thin oil film—big factors in reducing power losses and heating.

"Crowned" Rollers Relieve End Stress

TRU-ROL offers the extra advantage of a finish-ground "crown" radius on the roller ends. That relieves high end-stress and insures uniform load distribution over the entire length of the roller. The result: TRU-ROL Steel Cage Bearings carry heavier loads over longer periods without excessive end-fatigue. They are less affected by slight misalignment or shaft deflection.

Investigate TRU-ROL Steel Cage Roller Bearings before selecting any bearing in the medium price range.



♠ Rollway Metric Series Steel-Cage Bearings offer the greater load capacity of solid cylindrical rollers, plus the true right-line rolling of trunnion rollers turning in a rigid steel cage. There's no roller skew, no pinch out, no cam action. Design permits maximum bearing capacity . . . within small space . . . at moderate cost.



Let Rollway Help...

ROLLWAY BEARINGS

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Our complete engineering and metallurgical services will gladly work with you on your problem. Simply write or wire any sales office. No cost. No obligation.

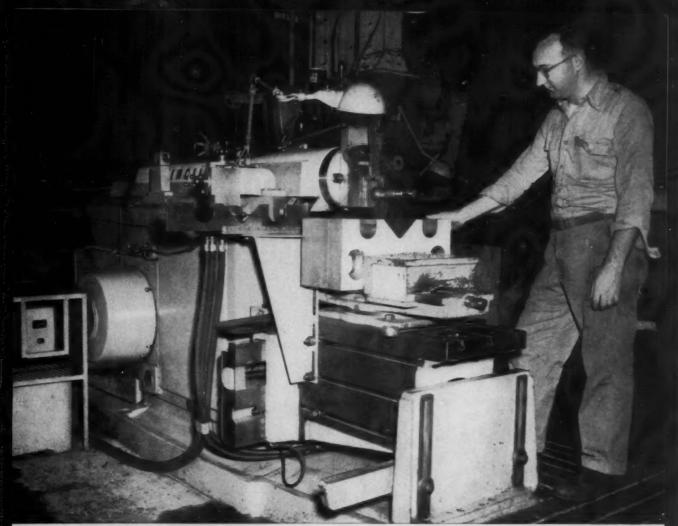
Rollway Bearing replacements are available through authorized distributors in principal cities. Consult your classified phone directory.

ROLLWAY BEARING CO., INC. SYRACUSE, N.Y.

ENGINEERING OFFICES: Syracuse * Boston * Chicago * Detroit * Toronto * Pittsburgh * Cleveland * Milwaukee * Seattle * Houston * Philadelphia * Los Angeles * San Francisce

272-MACHINERY, July, 1957

For more information fill in page number on Inquiry Card, on page 259



Photograph couriesy of Heppenstall Company, Pittsburgh 1, Pa.

High-alloy shear knives machined on accurate Cincinnati Rigid Shaper...

at HEPPENSTALL COMPANY, Pittsburgh 1, Pa.

This Cincinnati 36" Rigid Shaper, equipped with an automatic contouring unit, is machining high-alloy steel shear knives. These knives will be used to cut 3" round-cornered squared billets and $2\frac{1}{2}$ " rounds, by a leading Midwestern drop-forge company.

The heavily ribbed column, extended ram bearing and slot-free ram insure minimum deflection and maximum accuracy. Exclusive Cincinnati 50 psi pressure lubrication is real

insurance against wear. The Cincinnati electro-magnetic brake and clutch with finger tip control is positive and trouble free. Faster on the job... Easier on the operator.



Write Department D for Bulletin "Cincinnati Rigid Shapers". We also suggest you consult our Application Engineering Department regarding your machining problems.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A. SHAPERS - SHEARS - PRESS BRAKES





S MOST COMPLETE LINE

of hydraulic surface grinders



invites your attention...

name the surface grinding job. . . Thompson has the machine

Thompson Type B

Surface dies or parts faster to part print, at lower cost, within wide size range

Thompson Type F

For greatest precision, sensitivity and versatility in toolroom...or parts production at low cost

Thompson Type C

Meets production and cost demands in larger size surface work of all types

Thompson Type CX

Offers both power and precision for heavy duty production...fast, accurate

work size

6" x 18" to 12" x 120"

work size

8" x 18" and 8" x 24"

work size

12" x 40" to 24" x 168"

work size

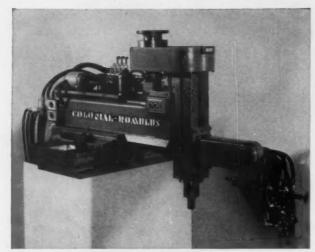
30" x 72" to 36" x 240" TEPPINA.

Grinders

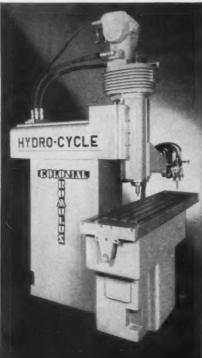
Including a complete line of Truform, Hydrail, Hydrovert, Twin Rotary and other special grinders for all sizes and types of work. write for descriptive data

HOMPSON GRINDER COMPANY

SPRING HELDS OHIO



3 New Lines for Faster, Lower-Cost Tracer Milling



Dupli-Mill Milling Unit (top) ...

in several sizes for easy positioning in individual or line setups. Completely self-contained machine . . . duplicating units with integrated tracers. Inexpensive, the units are proven work horses in long- or short-run production. Template guided by pencil-type tracer. Sizes range from 12x12 to 36x36 inches of longitudinal and cross travel. Ask for Bulletin CRH-57.

Hydro-Cycle Mills (center) . . .

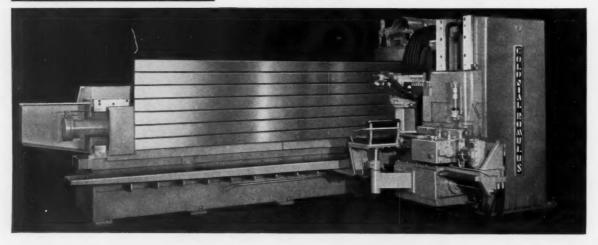
manually controlled precision contour mills for both aircraft plants and die shops. Available in two series of sizes: the first to 48x18 inches; the second series to 96x28 inches which can be supplied with multiple spindles. Infinitely variable spindle speeds with constant horsepower at any speed. High machine rigidity for heavy cutting or delicate work. Write for Bulletin CRH-57.

Sculpture Machines (bottom) . . .

for easier contour and profile milling of aircraft and missile parts. Several sizes available to suit different applications. Infinitely variable cutter speeds (from 40 to 3000 rpm). Easy to set up, operate and maintain to consistently high accuracy. Template and work clearly visible at all times. Chips fall free. Bulletin CR-56 gives full details.

COLONIAL-ROMULUS DIV.

ARKGROVE STATION • DETROIT 5, MICHIGAN



Introducing the new FEDERAL "55" for

JOBS... BIG and BULKY

Ram Area—11½" x 24" to 36"

Shut Height—12½" to 33½"

Throat Height—15" or 17"

Bolster Area—36" x 28"

Featuring oversize dimensions, the Federal "55" handles work formerly confined to larger, more costly equipment



Here is a press born to handle bulky jobs—laminations, die-cast trimming, progressive die work and the like. Check its important dimensions and you'll see why. This rugged, precision-built FEDERAL is a great press for other reasons, too. It embodies the many extra quality features that have made FEDERAL PRESSES famous the world over. Available in geared or flywheel models, with mechanical or air clutch. WRITE NOW FOR NEW CATALOG showing complete line.

Federal Press Company, 701 Division Street, Elkhart, Indiana

FEDERAL Andrew PRESSES

32 Years of Quality Construction

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American Bosch Arma Corp.
American Machine & Foundry Co.
American Type Founders, Inc.
Axelson Manufacturing Co.
Blanchard Machine Co.
Blaw-Knox Company
Bucyrus-Erie Co.
Cameron Machine Company
Caterpillar Tractor Company
Continental Gin Company
C. B. Cottrell & Sons Co.
Crankshaft Machine Company
Ekstrom, Carlson & Co.
Fellows Gear Shaper Co.
Fold Machiner & Corp.
Gillette Safety Razor Co.
Hartford Special Machinery Co.
Hartford Special Machinery Co.
Jeffrey Manufacturing Co.
Joy Manufacturing Co.

A. O. HOLMBERG, Vice President — Manufacturing
THE GOSS PRINTING PRESS COMPANY
Division of Miehle-Goss-Dexter, Incorporated

a man who came



"I first heard of the JIGMIL Technique for boring accurate holes in precise locations at an engineering lecture-meeting in Philadelphia. What I heard made me curious because the story seemed exaggerated."

Kempsmith Machine Company
Kidder Press Co., Inc.
McNally-Pittsburg Mfg. Corp.
Miehle Printing Press & Mfg. Co.
Morris Machine Tool Co.
Osborn Manufacturing Co.
Package Machinery Co.
Parrish Machine Co., Inc.
Rockford Machine Co., Inc.
Rockford Machine Tool Co.
Stary Machine Works, Inc.
Sunnen Products Company
George W. Swift, Jr., Inc.
Torrington Co.
Vandercook & Sons Inc.

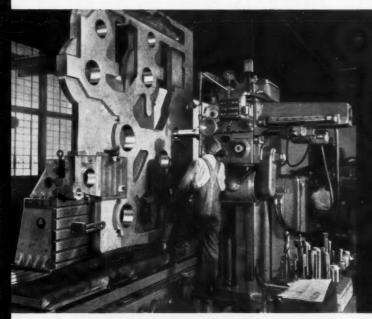
"I accepted an invitation to go to Fair Street and there saw the JIGMIL Technique in operation doing jigless boring to degrees of economy and precision that verified what I had heard in the lecture. The gains that were apparent from the analysis made for us by the DeVlieg engineers caused us to purchase a number of JIGMILS. These machines have been in use for several years. We have experienced many advantages. The principal ones are improved quality and a considerable reduction in machining, inspection and assembly times. The quality of the work resulting from the outstanding JIGMIL accuracy has had a far-reaching improving effect on the general quality and performance of our product."

A. O. HOLMBERG



WILL YOU BE THE NEXT TO VISIT FAIR STREET DEVLIEG MACHINE COMPANY

to Fair Street



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE—

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- · Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- · Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

A TYPICAL EXAMPLE OF JIGMIL ACCURACY

Goss uses the JIGMIL Technique for boring components of their famous high-speed newspaper, magazine and color printing presses. Illustrated above is one of the side frames for an 80 ft. multi-color press recently built by Goss. This part was bored on a Model 4B-120 SPIRAMATIC JIGMIL. JIGMILS were used for boring approximately 2260 holes in the side frames and gear boxes for this press. In the assembled press, the accuracy of hole size and spacing made it possible to hold the register of 5 colors within .001".

Our newest catalog will help you decide. May we send it?



DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES IN PRECISE LOCATIONS

450 FAIR STREET, FERNDALE, DETROIT 20



Will PRODUCTION LAPPING Prove Beneficial in MY Plant?

Get The Answer With

YOUR OWN FREE ANALYSIS

THE Lapmaster SERVICE

It's easy to prove to yourself whether production lapping will benefit your own manufacturing process...improve your product performance. Just send a few sample parts with surface finish specifications and production requirements to the Lapmaster Technical Service.

We'll test run them in our experimental lapping laboratory and furnish you with a full production report. This complete special analysis will give everything you need to determine how profitable the Lapmaster will be in your plant. Lapped samples will enable you to positively check product improvement.

More than 80% of the successful Lapmaster installations now in daily operation started with just such an analysis . . . and in the majority of cases, the results have shown substantial savings. However, if the application is not practical or profitable for you, we are frank to report it.



TECHNICAL BULLETINS FOR YOU—If you want additional information immediately, write for these latest technical bulletins on producing and measuring precision flatness and finish.





View of our experimental lapping laboratory showing some of the equipment available to test run your sample parts.



Our lapping laboratory is also equipped with the finest checking instruments to insure an accurate report of every experimental job.

WHAT YOU CAN EXPECT FROM A LAPMASTER

- Surface finishes of 2 to 3 RMS and surface flatness within tolerances of .0000116" with absolute uniformity piece after piece.
- No production bottlenecks frequently caused by other lapping methods.
- No downtime for truing lap plate . . . conditioning rings automatically keep plate flat and true.
- Product performance and quality improved . . . rejects cut to a minimum . . . inspection costs reduced.

Crane Packing Company, 6433 Oakton St., Morton Grove, III. (Chicago Suburb)
In Canada: Crane Packing Co., Itd., Hamilton, Ont.













TEFLON PRODUCTS LAPPING MACHINES TH

CRANE PACKING COMPANY

280-MACHINERY, July, 1957

For more information fill in page number on Inquiry Card, on page 259

Fluid Power ILWS

CYLINDERS

NOW AVAILABLE—New Oilgear "Custom-Quality" Line of Heavy-Duty, 3,500 psi Cylinders

Check...Compare these 20 "Custom-Quality" features:

- Four-bolt, face-mounted steel pipe flangesstraight, angle, or multiple port . . . pipe taps, straight taps, or sockets for welded connection available in various sizes.
- 14 Four closely fitted, automotive-type pisten rings are retained in precision-cut piston grooves for effective sealing and exceptionally long life.

13 Thick-walled, seamless steel

all-dime

cylinder-precision bored.

laned, polished and gauged for

sional accuracy

12 Short steel tie bolts-eliminate axial tension or compression load on cylinder. Either head can be removed independently without disrupting entire cylinder.

- 2 Leak-proof seals-confined, preloaded "O" rings between flanges and heads...
- 3 Molded, non-abrasive, oilresistant ram wiper retains sharp edge to uniformly clean ram.



- Two ram sizes-large and
- standard diameters—are ground and polished. Special ends. hardened or alloy steel, chrome plating also available on re-
- 6 Spring-louded, "V" type molded ram packing for automatic sealing action—low uniform friction. Independent face-mounted bushing gland prevents tightening or binding.
- 7 Machined steel flonges welded to cylinder for greatest rigidity. Permit sealed, face-mounting of heads—eliminating loose flanges, grooves, split-ring retainers, dirt gaps.
- 8 Piston is pressed and welded to ram for absolute concentricity, longest life, strength, rigidity-eliminates threads, seals, spacers, lock pins, etc.
- 9 Dual ram guides-large area bronze bushings in front heads See 7 and on pistons give proper end support, resist side thrusts and rom sag.
 - Machined, bar steel heads 11 -rugged, shock-resistant. Extra large possages reduce fluid velocity
 - 10 Leak-proof static and pressure seals—confined, pre-"O" rings between cylinder flanges heads. Face-mounting eliminates high initial bolt stress, compression or tension distortion
- 15 Adjustable hydraulic cushions—dash pots—for front, rear, or both heads. New, exclusive Oilgear floating-sleeve design assures superior performance, longer life, less wear-eliminates check valves.
- 16 Eight basic sizes—2", 2½", 3¼", 4", 5", 6", 7", 8" . . . length of stroke varies from 36" to 158". Longer stroke available on request.
- 17 Air vent plugs, double end rams, special ram ends, special packings for use with fire-resistant fluids are also available.
- 18 Choice of fixed mountings—foot lug, center lug, or flange—can be combined or interchanged, front or rear, to suit any requirement.
- 19 Choice of hollow trunnion mountings—rear, center, front—accurately machined, integral with heads. No hoses or slide joints-Oilgear's exclusive steel flange connectors—rugged, leak-proof, rotate smoothly.
- 20 Designed and built to the highest standard of quality for the most dependable, trouble-free, long life. Machinery builders and users alike, say—"For the lowest cost per year—it's Oilgear!"

Complete user satisfaction is guaranteed by Oilgear's extensive research, testing, over 35 years of design, manufacturing, and application experience in the field of Fluid Power -both oil and fire-resistant fluids.

For further information on these new cylinders, call your Oilgear Application-Engineer. Or write for bulletins 73000 and 73245 directly to . . .

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1569 WEST PIERCE STREET . MILWAUKEE 4, WISCONSIN

STANDARD MOUNTINGS





Heads can be combined or interchanged





Rear flange mounting plain front head

Front flange mounting plain rear head





plain front head

plain rear head (not shown)



Center trunnion mounting, plain front and rear heads





"Buffalo" No. 16 DRILL

leading aircraft builders use "BUFFALO" to cut costs, boost production, meet

DESIGNED SPECIFICALLY FOR AIRCRAFT BUILDERS

SHAPES, FORMS, BENDS-QUICK, EASY RETOOLING-VARIABLE SPEED DRIVE

The "Buffalo" Type "OA" Bending Roll was designed in cooperation with prominent aircraft manufacturers to supply a bending roll that would meet their stringent requirements. The "OA" bending roll performs complicated bending jobs speedily and efficiently. Complete retooling can be accomplished in a very few minutes. Special rolls and attachments are available to extend its range of usefulness. Speeds from 15 to 60 R.P.M. are at the command of the operator. A built-in electric brake provides instantaneous motor control in either direction. Bulletin 3344-A gives full details and capacities; write for it now.

EXTREME SENSITIVITY – plus rugged, dependable construction make the "Buffalo" No. 16 Drill ideally suited to a wide variety of aircraft operations. Your choice of 8 inch, 12 inch and 15 inch overhang — bench, floor or pedestal types — multiple units up to 6 spindles. You can order the "Buffalo" No. 16 Drill with power feed, motor-reverse tapping and many other special variations. Write for Bulletin 2730G.

A HIGH GRADE DRILL—the No. 18 is easy to operate. Combining good sensitivity with rigid, durable design at a moderate price, it will perform a broad range of production and shop applications in the aircraft field. Suitable for general work up to 1 inch cast iron. Nineteen models available in bench and floor types, with multiple units up to 6 spindles in pedestal model. Write for full details on the "Buffalo" No. 18 Drill—ask for Bulletin 3123E.

The "Buffalo" Machine Tools on these pages — like all "Buffalo" products — feature the famous "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.





BUFFALO FORGE

Canadian Blower & Forge

machine tools quality standards

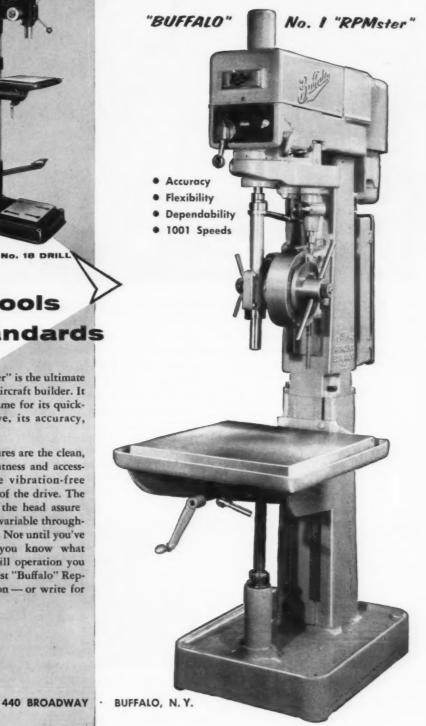
The "Buffalo" No. 1 "RPMster" is the ultimate in drilling machines for the aircraft builder. It has achieved industry-wide fame for its quickchange variable speed drive, its accuracy, durability and versatility.

Outstanding "RPMster" features are the clean, streamlined design - the neatness and accessibility of all controls—the vibration-free operation - the fine balance of the drive. The two handles at the front of the head assure easy speed changes, infinitely variable throughout both high and low ranges. Not until you've tried the "RPMster," will you know what smooth and vibration-free drill operation you can command. Call your nearest "Buffalo" Representative for a demonstration - or write for Bulletin 3967-A.

COMPANY

Co., Ltd., Kitchener, Ont.

FAVORITE OF THE AIRCRAFT INDUSTRY





gap lathes perfect for aviation machine shops

Aircraft manufacturers and operators are finding Nebel extension bed gap lathes the most useful tools in the machine shop. The sliding upper bed opens up a wide, deep gap that accommodates parts like the R-2800 engine case shown above...landing gear struts for the DC's (6, 7 & 8) . . . parts for the new Viscount, world's first turbo-prop airliner . . . and

many other outsize, oddshaped parts.

And with the gap closed, the lathe will turn all your standard lathe work as well.

You benefit enormously from the capacity, speed, power and performance these productive lathes offer. Made in three different models and many sizes (see below), there's a Nebel

gap lathe that will fit your requirements exactly.

Nebel also manufactures removable block gap lathes, 16"/27", 20"/30" and 25"/50" swing sizes: and engine lathes 16" to 36". For complete information, send today for descriptive bulletins. Nebel Machine Tool Corp., 3410-A Central Parkway, Cincinnati 25, Ohio.



Nebel's double duty gap lathe/standard lathe feature means low capital investment and more efficient use of floor space. These versatile lathes have been welcomed for production and maintenance machining by these aircraft manufacturers and airlines:

North American Aviation, Inc. Braniff International Airways Hughes Aircraft Co. Solar Aircraft Co. Capital Airlines

Eastern Air Lines, Inc.

Pan American World Airways System

Nebel Extension Bed Gap Lathes

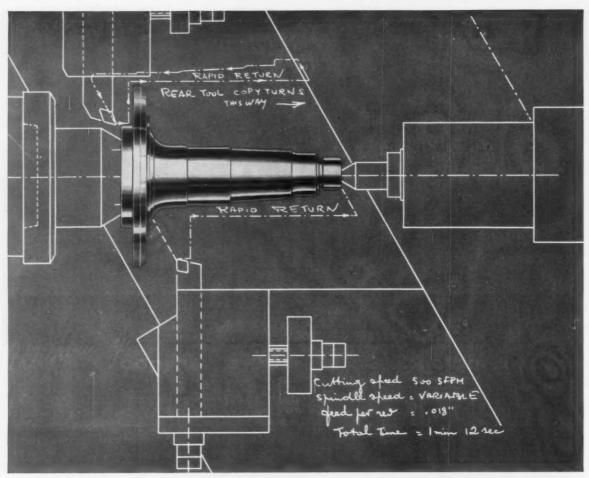
Nebel offers a complete range of models and bed lengths. You're sure to get exactly the type and size you need.

	Swing over	Swing thru	Width of	Bed I	ength+	Spindle speeds	Motor	
	ways	gap	gap*	Minimum	Maximum		Recommended	
Imperial 20"/40"	241/2"	42"	32"	8 ft.	30 ft.	11-666 or 16-1000	15-20	
AG series 20"/40"	221/2"	40"	24"	6 ft.	20 ft.	9-280 or 16-500	71/2-10	
G series 28"/50"	29"	52"	41"	10 ft.	30 ft.	5-230 or 10-460	20-25	

on shortest bed length

tincreasing in increments of 2 ft.





Without special tooling the Conomatic Pilot can copyturn a 90° reverse shoulder like this

With the Conomatic Pilot copying lathe, you can copyturn a 90° reverse shoulder with a single cross slide. Although this hydraulically-controlled multicycling lathe can be equipped with as many as two infeed slides and two cross slides, its ability to copyturn in reverse often makes costly special tooling unnecessary.

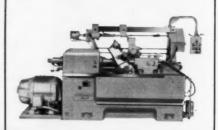
For example, the 90° reverse shoulder on the automatic transmission part shown above is copyturned in reverse by the rear tool on the 60° cross slide when the lathe's motorized template indexes after the front tool has completed its pass. Total time is 1 minute 12 seconds, with a gross production of 50 pieces per hour.

Write us today for a brochure giving details and specifications of the Conomatic Pilot—the world's most versatile copying lathe.

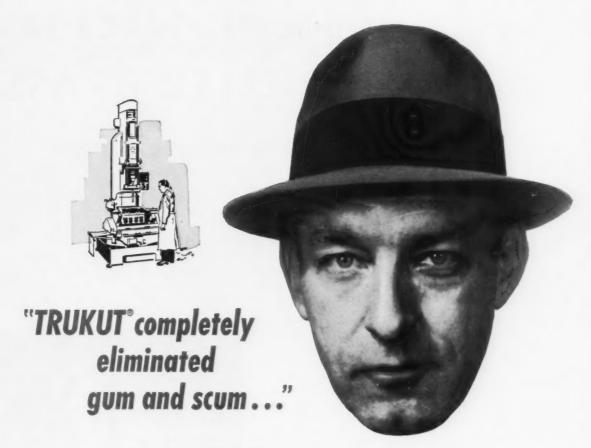
Conomatic

CONE AUTOMATIC MACHINE CO., INC., WINDSOR, VT.
PILOT DIVISION

30 Rockefeller Plaza, New York 20, N. Y.



The Conomatic Pilot Model KU: A hydraulically-controlled multicycling copying lathe with piloted hydraulic feed that provides constant feed per revolution. Motorized rotating template provides up to four passes and four rapid returns or four additional passes in reverse. Adapted to completely automated loading and unloading.



A large manufacturer of mold bases had a problem with grinding coolants. The grinding oil mist was causing a heavy gummy scum to form on the machines and floors.

Sinclair Representative J. H. Schindler was called in to help solve the problem. Mr. Schindler reports: "I knew from actual experience that Sinclair TRUKUT EP Soluble Oil, Grade C, would give good wheel life and fine finishes without gum or scum. I submitted a 5-gallon sample for test. After changing to Sinclair's grinding coolant, the gum and scum were completely eliminated.

"Within a month, this plant swung over to TRUKUT in all grinders, as well as milling machines."

If you have a problem with grinding or cutting coolants, it will pay you to look into the advantages of Sinclair TRUKUT EP Soluble Oils. Contact your local Sinclair Representative, or write to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N.Y. There's no obligation.

SINCLAIR

CUTTING OILS and COOLANTS

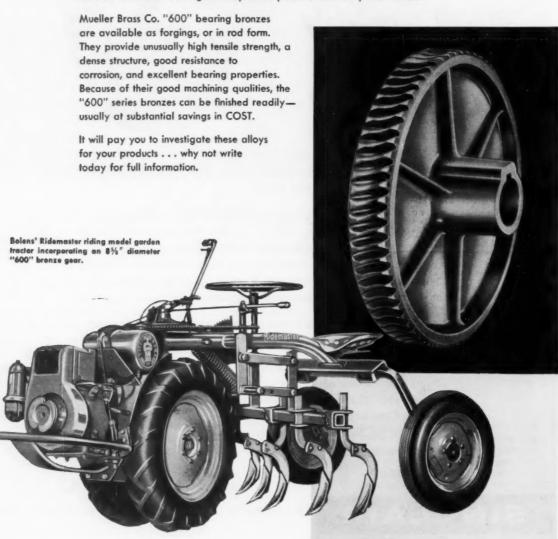
For more information fill in page number on Inquiry Card, on page 259

MACHINERY, July, 1957-287

drive gears in BOLENS TRACTORS toughness of MUELLER BRASS

"600" series bronze alloys

Forged bronze gears made from tough, long-wearing Mueller Brass Co. "600" bearing alloy are proving their ability to withstand punishment in the popular outdoor power equipment manufactured by the Bolens Products Division of Food Machinery and Chemical Corporation, Port Washington, Wisconsin. The Junior and Super Mustang rotary tillers, all employ "600" main drive gears to dependably transmit engine power to drive assemblies. The going is rough for equipment of this type in cultivating or tilling heavy soil—but Bolens has a record for ruggedness and, on these and many other Bolens products as well, Mueller Brass Co. "600" gears help make possible that fine performance.



and TILLERS prove CO.



METALS AND ALLOYS REVIEW



by FRANK M. LEVY

Vice-President and Director of Research

One of the most interesting things about our 600 series bearing alloys is the great variety of products in which they find application. In the advertisement to the left you can see how the Bolens people put 600 gears to work in their rotary tillers and garden tractors. Those gears are big, take a lot of abuse, and meet the job needs perfectly. We also make a lot of small parts, too, that have been specified because of the many unusual properties of this series of alloys.

One good example that comes to mind is a shaft bushing on a rotary selector switch that we make for an instrument manufacturer. This selector is used for switching sound-powered telephone circuits aboard Naval vessels. One of the most important considerations in the choice of 600 alloy for this bushing was its resistance to abrasive action on and against a rubber "O" ring. The acceptance test required a stainless steel shaft riding in the bushing to rotate "dry" for a minimum of 50,000 cycles consisting of 360° rotation clockwise followed by a 360° rotation counter-clockwise. The "O" ring must still form a watertight seal at the end of the test. Our 602 alloy was the only one of several materials tested that met the specs. That was pretty good evidence in itself of resistance to abrasion, but, in addition, this customer also found that the use of 602 eliminated the headaches they previously had with seizing and galling.

The pounding action caused by the indexing mechanism attached to the shaft used to give them no end of seizing troubles. The chief product engineer is extremely happy about the way our alloy is performing. Mention was also made of the fact that the corrosion resistance of 602 was mighty impressive. In this application, the alloy passed the 200-hour Navy salt spray test with flying colors.

So, big or small, it seems that there is no end of applications for 600 series alloys. We even have parts working in a machine that slices frankfurters as well as gears in fishing reels. So, it seems that 600 runs the gamut from "red hots to reels". Well, it looks like the end of the page is here again, so I'll close for now. However, if you have any problems or questions about non-ferrous alloys or you're having trouble getting desired performance from a part, why not drop me a line here in Port Huron, and possibly I can be of some service. Send a part print along if you like, and we'll be glad to make proper recommendations.

Thanks again for your time.

108



MUELLER BRASS CO.

PORT HURON 27, MICHIGAN

For more information fill in page number on Inquiry Card, on page 239

MACHINERY, July, 1957-289

here's how Seeburg matches P-K° fasteners to the job

And Parker-Kalon's wide range of types and sizes makes it possible

"By carefully selecting the right P-K screw for each assembly we've reduced rejects and stepped-up production," says Joseph Kamys, engineer of J. P. Seeburg, manufacturers of the famous line of Select-O-Matic "200" Coin Operated Phonographs.







◄ "Take the fastening of metal kickplates and base moldings to wood cabinets, for example. They must hold permanently and go in fast without splitting the wood. P-K Type-A Self-tapping Screws are just right for the job."



"In a metal-to-plastic application such be as the fastening of high-frequency speakers to formed plastic housings—P-K Type-Z thread-forming Screws go in right without cracking the plastic—stay put, even under high vibration."







◄ "In this important subassembly, appearance is important as well as dependable holding power." Here we use P-K Type-A Phillips Recessed Head Screws in a metal-to-metal application."

Whatever your product or application . . . ferrous or nonferrous castings, sheet metal or structural steel, plywoods, asbestos compositions, pliable or brittle plastics . . . Parker-Kalon can furnish the proper fastener to speed assembly, reduce rejects, cut costs! PARKER-KALON

Sold Everywhere Through Leading Industrial Supply Distributors.

fasteners

PARKER-KALON DIVISION, General American Transportation Corporation. Factory: Clifton, New Jersey.

290-MACHINERY, July, 1957

For more information fill in page number on Inquiry Card, on page 259



Make every cent of your GRINDING WHEEL DOLLAR COUNT

with MACKLIN "Wheels of Profit"

Whatever the grinding job . . . tool sharpening, surface grinding, cylindrical grinding, or metal cut off, you'll find a Macklin tool room wheel of the right type, the right size, the right abrasive and bond.

The reason? Macklin's abrasive experience and modern-as-tomorrow productive capacity. Each wheel is expertly engineered and precisely manufactured to assure you top results, wheel after wheel, job after job.

Job-test a Macklin wheel in your plant.

Reach for the phone and call your Macklin distributor.

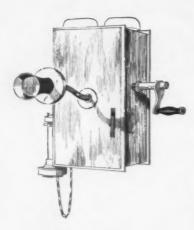
You'll find IT PAYS to know him well.

NEW I
Macklin's V-8 Wheel
is tops for all carbide
grinding. Test it on
your job today. WRITE

AGKLINCOMPONY Jackson, Mich.

DEPT. 14

Great in its day...



BUT WOULDN'T YOU

RATHER HAVE THE LATEST

TECHNICAL ADVANCE?



Now...

another significant advance in a great tool line

Heller Vob Tempered"

Flat Ground

Die Steel

Heller's new JOB TEMPERED Flat Ground Die Steel is a truly significant advance in the field.

For one thing, its analysis is recommended by a group of leading consulting metallurgists. For another, it is precision-ground to a smooth surface finish of 25 to 35 micro-inches with all surface defects and decarburization removed to save time and effort in tool making.

It's easy to heat-treat, too. For instance, Heller Oil-Hardening Die Steel will achieve a Rockwell C hardness of 64-65 when hardened within a temperature range of 1450°F. to 1540°F. And a similarly wide range applies to the Air-Hardening type. Simple tempering instructions are supplied with each piece, so the entire heat-treating process is non-critical and virtually foolproof. As a result, you are sure of getting all the benefits of JOB TEMPERED tools, dies, jigs and fixtures when they're made from this superior Heller Die Steel.



Check
the Die Steel
or
Tool Steel
you may be
using now.

Then let us show you why Heller JOB TEMPERED Die Steel is more efficient and economical to use... and will turn out tools that will do the job better and last longer.

Here are the Facts!

Heller's new folio of JOB TEMPERED Flat Ground Die Steel will give you full information on sizes and types available, heat treating, applications, physical properties, etc.

Write today for your copy.



... the analysis recommended by leading consulting metallurgists for Job Tempered Tools and Dies





AUTOMOTIVE AUTOMATION ...

These two different examples of automatic high production machines demonstrate the imaginative engineering which has earned for Hartford Special such a fine reputation among automotive manufacturers.

But Hartford Special automated equipment is not limited to large plants. The same standard machine components which we use in our own complete machines are available to you as separate elements for assembly into complete machines on your floor. The components include quill type drilling units, lead screw tapping units, power operated index tables, columns and machine bases. Thus the benefit of automated equipment can be had by small plants or by shops faced with diversified mass production.

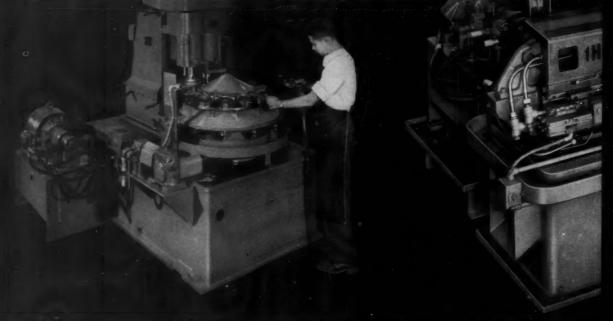
Whichever way you need automation — complete machines or "building block" components — Hartford Special is your most efficient and economical choice.

CONTINUOUS MILLING MACHINE

mills the top and bottom pad of generator end castings. Work is automatically and continuously fed between revolving cutters of variable speed milling heads. Speed of rotation of power table and milling heads can be regulated to suit conditions. Production rate is 625 pieces per hour.

FIVE STATION AUTOMATIC INDEX MACHINE

performs multiple operations on automotive power steering gear box simultaneously. Machining includes angular milling, drilling, reaming, spherical seating and facing. This machine features hydraulic power clamping, automatic lubrication and variable feed milling head.



"OFF-THE-SHELF" COMPONENTS BY HARTFORD SPECIAL

Write for descriptive literature.





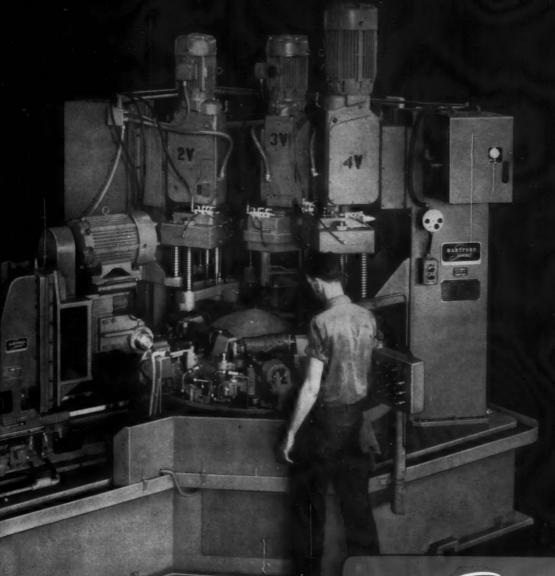






AUTOMATIC AIR-HYDRAULIC DRILL UNITS AUTOMATIC CAM TYPE DRILL UNITS COLUMNS

.. Created by Hartford Special



Hartford also makes automatic Thread Rolling Machines and the world famous Super-Spacer.



MACHINE TOOL DIVISION
THE HARTFORD SPECIAL MACHINERY CO.





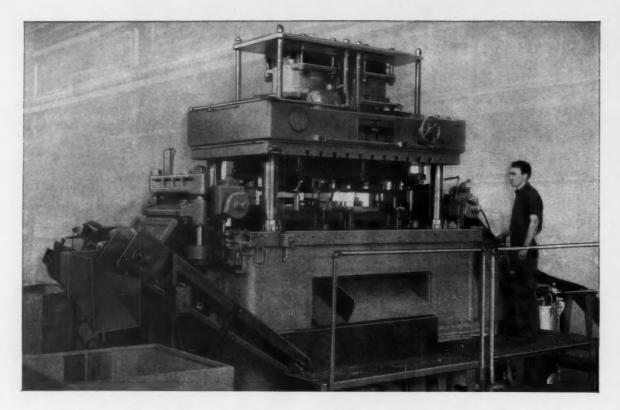


2907 HOMESTEAD AVE., HARTFORD 12, CONN.

CIRCULAR BASE TOP

INDEX TABLE SUPPORT

PEDESTALS



Henry & Wright Double Crank

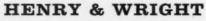
"definitely improved our competitive position"

TO KEEP PACE with trends in progressive stamping, Grand Haven Stamped Products Co., Grand Haven, Mich., bought a 100-ton Single Crank Henry & Wright in 1954. Its performance was so impressive, Grand Haven purchased a 200-ton Double Crank in 1956.

ON VERY FIRST JOB the new machine equalled expectations. The part involved — an automotive vent grill — is produced two at a time on a multi-station die from a 155%" strip of 22-gauge, cold-rolled steel, at 124 pieces per minute.

THREE OR FOUR conventional presses would have been required to produce this part, it is estimated by Emil Gaul, Grand Haven vice president. Among the features he likes about the Double Crank are: unequalled flexibility afforded by the large bed area, rapidity of die change, inching control and safety devices.

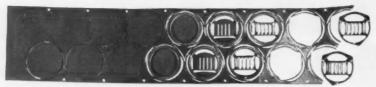
"Definitely improved our competitive position," is the way Mr. Gaul sums up the performance of his Henry & Wrights. They can improve productivity and work quality in your plant, too. Write for our catalog.



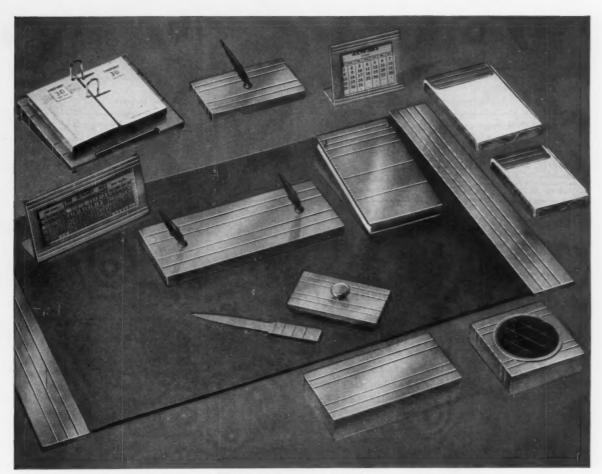
Division of Emhart Mfg. Co.

Hartford, Connecticut





Six- and seven-station twin die lances, flattens, draws, pierces, forms and blanks out.



A few of the fine executive desk appointments made of Formbrite by Smith Metal Arts Co., Inc.

For a superfine luster that lasts—superfine-grain Formbrite

Smith Metal Arts Co. uses easy-to-polish, scratchresistant Formbrite to add value to its line of distinguished desk appointments.

The fine executive desk appointments made by Smith Metal Arts Co., Inc., Buffalo, N. Y., are not just polished to shine. They are brought up to a beautiful deep luster. For their line of brass accessories they use Formbrite, [®] Anaconda's superfine-grain drawing brass.

They have found that the fine, uniform grain size of Formbrite enables them to give their pieces a superior, more uniform texture. The luster, furthermore, stands up better under handling because Formbrite provides a harder, more scratch-resistant surface.

In order to achieve this fine luster, Smith Metal Arts Co. must do an exceptional amount of polishing and they have chosen Formbrite because of its superior polishing characteristics. By using Formbrite they can achieve their high quality surfaces at savings of 20% over the use of ordinary brass.

See for yourself. Formbrite is a premium product at a nonpremium price. Find out for yourself how its superfine grain, excellent drawing properties, strength, and scratch resistance can help you improve product quality, lower finishing costs. Write for Publication B-39. Better yet, ask for a sample or details on our trial order offer. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.



an $\mathbf{ANACONDA}^{s}$ product

Made by The American Brass Company

MACHINERY, July, 1957—297

Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt

Carborundum Co., Niagara Falls, N. Y. Crane Packing Co., Morton Grove, III.

ABRASIVES, Discs

Carberundum Co., Niagara Falls, N. Y. Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Gardner Machine Co., Beloit, Wis. Macklin Co., Jacks:n, Michigan Norton Co., 1 New Bond St., Worcester, Mass. Simonds Abrasive Co., Tocony and Fraley Sts., Bridesburg, Philadelphia, Pa.

ABRASIVES, Polishing, Tumbling, Etc.

Carborundum Co., Niagara Falls, N. Y.

Heavy duty attachments

of dependable, low-cost

"THE MOST MILL FOR THE LEAST MONEY"

Make your own comparison of 22 specifications of

A full line of attachments and accessories offer

outstanding flexibility for all types of milling operations . . . with GREAVES MILLS.

increase versatility

Crane Packing Co., Morton Grove, III. Macklin Co., Jackson, Michigan Norton Co., I New Bond St., Worcester 6, Mass. Simonds Abrasive Co., Tacony and Fraley Sts., Bridesburg, Philadelphia, Pa.

ACCUMULATORS, Hydraulic

Watson-Stillman Co., Roselle, N. J. Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

AIR GAGES, Dimensional-See Gages Air Comparator

AIR GUNS

Chicago Pneumatic Tool Co., New York 17, Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS-See Grinders, Portable, Pneumatic Drills, Portable, Pneumatic,

ALLOY STEELS

AlLOY STEELS

Allegheny Ludlum Steel Corp., Pittsburgh, Pa. Bethlehem Steel Co., Bethlehem, Pa. Carpenter Steel Co., Reading, Pa. Columbia Tool Steel Co., Chicago Hts., III. Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 30, Pa. Firth Stefling Inc., 3113 Forbes St., Pittsburgh 30, Pa. Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, III. U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa. Vanadium Alloys Steel Co., Latrobe Pa. Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing

Bunting Brass & Bronze Co., 715 Spencer Toleda 1, Ohio Carpenter Steel Co., 105 W. Bern St., Reading, Pa. Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa. Mueller Brass Co., Port Huron, Mich.

ALLOYS, Non-terrous-See Brass, Copper, Zinc and Stellite

ALUMINUM and Aluminum Products

Mueller Brass Co., Port Huron, Mich. Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y. Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

ANGLE PLATES—See Set-Up Equipment

ANNEALING FURNACES

Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J. General Electric Co., Schenectady, N. Y. Holcroft & Co., 6545 Epworth Blvd., Detroit 10, Mich.



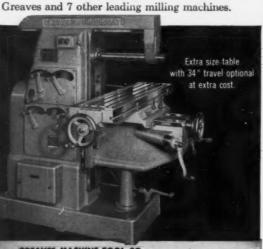
Heavy Duty Vertical





Universal Milling Attachment



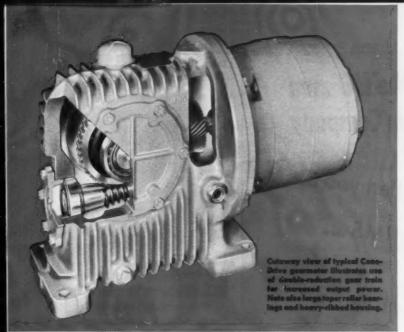


GREAVES MACHINE TOOL CO. 2500 Eastern Avenue, Cincinnati 2, Ohio

Send Comparison Chart. I will make my own comparison of GREAVES MILLS with other makes.

Send information on Attachments and Accessories for GREAVES MILLS.

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Announcing a POWERFUL NEW DRIVE by CONE-DRIVE GEARS

Here are the "why's" for this new gearmotor

Why a right-angle gearmotor?

You save space! By tucking the entire unit in close to the driven shaft, there's nothing to stick out incrowded aisles. It's out of the way.

Why a double-reduction design?

More power! Combining a helical primary with a Cone-Drive double-enveloping worm gear secondary gives you an extremely high load-carrying capacity. Output torque ratings are much higher than those of single reduction gearmotors. Overall ratios are greater, too.

Why double-enveloping worm gears?

More power! Cone-Drive doubleenveloping worm gears have proven that they provide maximum load carrying capacity on extremely small center distances. This means, in many cases, that they will handle two to four times the load of cylindrical worm gears of the same size. An added plus is high resistance to shock loads, long operating life and minimum maintenance requirements.

Why different types of mountings?

Flexibility! You can select Cone-Drive gearmotors with extended shaft or for shaft mounting. Both are standard. Shaft mounting often permits "hanging" the driven load on the gearmotor to eliminate pillow blocks, bearings, torque arms, shafts, pulleys, bed plates, etc. Both types may be floor, wall or ceiling mounted as desired.

Why 27 standard output speeds?

Standardization! Standard reductions range from 3.3:1 to 240:1. Speeds at 1750 rpm input range from 525 rpm to 7.3 rpm output speed. Any variation in input speed will naturally provide another complete set of 27 output speeds. Any standard type NEMA D-flange motor may be used. Other reductions may be obtained on special order at additional cost.

Why ratings to only 25 horsepower?

Demand! Extensive market research by Cone-Drive Gears reveals that this is the most popular power range in the application of gearmotors by industry. Currently we are building models in capacities from 1 to 25 horsepower. However

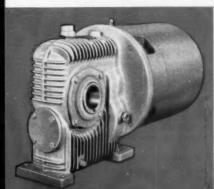
the compact size and high capacity of the Cone-Drive gearmotor will extend this range in the future. Space requirements for higher capacities will be substantially reduced with our new design.

Why a Cone-Drive gearmotor?

Dependability! For over 20 years Cone-Drive Gears has been building double-enveloping worm gears and speed reducers. Design and manufacturing techniques have been constantly improved so that today these unique gears provide, size for size, the highest load-carrying capacity of any right angle worm gearing. Now, you can take advantage of this outstanding gearing combined into an integral package that eliminates pulleys, sheaves, belts, chain, bearings and all the trouble that goes with separate reducer and motor combinations. You'll get increased efficiency at lower cost by specifying standard Cone-Drive gearmotors.

Bulletin #57 contains complete details. Ask for it today.





Here's the finest shaft mounted gearmoter on the market today. It is available in all sizes with ratings identical to other Cone-Drive gearmoters.

MESSAGE from the NO men of Laminated Shim Company

You lose NO time when you use LAMINUM SHIMS ...

> NO machining! NO grinding! NO counting! NO stacking! NO miking!



... and NO dirt between layers - ever!



	1
Laminated Shims o	f
LAMINUM	
now available in	

STEEL with laminations of .002" or .003"	ALUMINUM with laminations of .003" only	
BRASS with laminations of .002" or .003"	LOW CARBON STEEL with laminations of .002" or .003"	

LAMINATED SHIM COMPANY, INC.

3907 Union Street, Glenbrook, Conn.

ARBOR PRESSES-See Presses Arbor

ARBORS AND MANDRELS

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Brown & Sharpe Mfg. Co., Providence, R. I.

Chicago-Latrobe Twist Drill Works, 411 W.

Ontario St., Chicago, III.

Cleveland Twist Drill Co., 1242 E. 49th St.,

Cleveland, Ohio

Jacobs Mfg. Co., West Hartford, Conn.

Kearney & Trecker Corp., Milwaukee 14, Wis.

Logansport Mch. Co., Inc., Logansport, Ind.

South Bend Lathe Wks., South Bend 22, Ind.

Wesson Co., 1220 Woodward Heights Blvd.,

Ferndale, Mich.

Whitman & Barnes, 40600 Plymouth Rd.,

Plymouth, Mich.

ARC WELDERS-See Welding Equipment, Arc

ASSEMBLING MACHINES

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y. Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.

AUTOMATIC SCREW MACHINES-See Screw Machines, Single- and Multiple-Spindle Automatic

BARRITT

Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, III.

BALANCING EQUIPMENT

Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, 1245 E. Washington Ave., Madison 10, Wis.
LaSalle Tool, Inc., 3840 E. Outer Dr., Detroit 34, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, III.

BALL-MAKING MACHINES

New Departure Div., Bristol, Conn.

BALLS

aynes Stellite Co., Kokomo, Ind.

BAR MACHINES-See Screw Machines, Single- and Multiple-Spindle, Auto-

BAR STOCK, Non-ferrous

American Crucible Prod. Co., Port Huron, Mich.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Mueller Brass Co., Port Huron, Mich.
Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, III.

BAR STOCK AND SHAFTING, Steel

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa. Boston Gear Works, 14 Hayward St., Quincy 71, Mass. Carpenter Steel Co., 105 W. Bern St., Reading, Pa. Pa.
Crucible Steel Co. of America, Henry W.
Oliver Bldg., Mellon Sq., Pittsburgh 22, Pa.
Cumberland Steel Co., Cumberland, Md.
Ryerson, Jos. T., & Son, 2558 W. 16th St.,
Chicago 18, III.

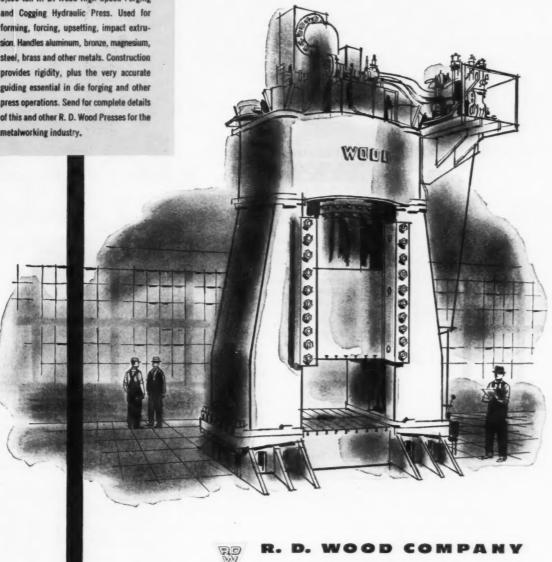
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For proof, look at production records—and downtime for maintenance. Then watch an R. D. Wood Press at work. See for yourself the smooth, precise operation—the dependable performance—even under tough conditions. Finally, inspect an R. D. Wood Press up close. Notice the soundness of design, the excellence of materials, the scrupulous care given to each detail of construction. These are the reasons why R. D. Wood Presses have been the standard of excellence throughout the metalworking industry.





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BEARINGS, Ball

BEARINGS, Ball
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Boston Gear Works, 3200 Main St., North
Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg.,
Jamestown, N. Y.
New Departure Div., Bristol, Conn.
Nice Ball Bearing Co., 30th & Hunting Park
Ave., Philodelphia, Pa.
Norma-Hoffman Bearings Corp., Stamford,
Conn.

BEARINGS, Bronze and Special Alloy
Boston Gear Works, 3200 Main St., North
Quincy, Mass.
Bunting Brass & Bronze Co., Spencer and Carlton Aves., Toleda, Ohio.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Haynes Stellite Div., Union Carbide & Carbon
Corp., 30 E. 42nd St., New York, N. Y.

BEARINGS, Needle

Orange Roller Bearing Co., Inc., Orange, N. J.

BEARINGS, Oilless

Bunting Brass & Bronze Co., 715 Spencer, Toledo I, Ohio. Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, III.

BEARINGS, Roller

Ball & Roller Bearing Co., Danbury, Conn. Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y. Norma-Hoffman Bearings Corp., Stamford, Conn. Orange Roller Bearing Co., Inc., Orange, N. J. Rollway Bearings Co., Inc., 541 Seymour St., Syracuse, N. Y. Timken Roller Bearing Co., Canton, Ohio.

BEARINGS, Thrust

BEAKINGS, Infust
Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., Spencer and Carlton Aves., Toledo, Ohio.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Fafriir Bearing Co., New Britain, Conn.
General Electric Co., Schenectady, N. Y.
Marlin-Rockwell Corp., 402 Chandler Bldg.,
Jamestown, N. Y.
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Pa. Pa. Norma-Hoffman Bearings Corp., Stamford, Conn. Orange Roller Bearing Co., Inc., Orange, N. J. Rollway Bearing Co., Inc., Syracuse, N. Y. Timken Roller Bearing Co., Canton, Ohio.

BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS

Brown & Sharpe Mfg. Co., Providence, R. I. Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa. Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

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BENDERS, Bar, Tube, Channel, etc.
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Greeniee Bros. & Co., 2136—12th St., Rockford, III.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, III
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDERS, Cleat Smith, R. E., Waukegan, III.

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Cincinnati, Ohio.
Niagara Mch. & Tool Wks., 637 Northland
Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, III.

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Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa. Bethlehem Steel Co., Bethlehem, Pa. Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. Chambersburg Engrg. Co., Chambersburg, Pa. Hannifin Corp., 501 Wolf Rd., Des Plaines, III.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio.
Lake Erie Engrg. Corp., Kenmore Sta., Buffalo,
N. Y.
Niogara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Ottemiller, W. H., & Co., York, Pa.
Parker-Kalon Div. Clifton, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Standard Pressed Steel Co., Jenkintown, Pa.
Williams & Co., J. H., 400 Vulcan St.
Buffalo 7, N. Y.

BOOKS, Technical

Industrial Press, 93 Worth St., New York 13, N. Y.

BORING BARS

BORING BARS

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.

Bullard Co., 286 Canfield Ave., Bridgeport 6. Conn.

Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

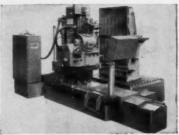
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Ingersoll Milling Machine Co., 2442 Dougla St., Rockford, Ill.

Lovejoy Tool Co., Inc., Springfield, Vt.

Metallurgical Products Dept. of General Electric Co., Box 237 Roosevelt Park Annex, Detroit 32, Mich.

(Continued on page 804) (Continued on page 304)



A P&W Tracer-Controlled MILLER FOR EVERY JOB

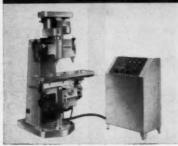
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... A powerful, versatile machine made in a range of sizes from 5' x 2½' to 10' x 4' in single spindle or 2-spindle models.

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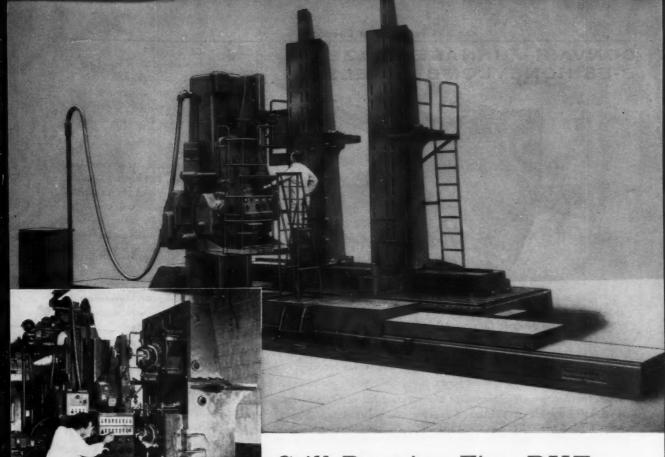
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.. Duplicates the finest detail with extreme precision. New, non-contacting tracer accurately follows any 3-dimensional model without touching it. Cannot damage the softest, most fragile models.

Automatic Duplicating Machine

... Specially designed for low cost production of forging dies and molds for glass and plastic. Automatically re-produces original dies and molds with precision and remarkable detail. There are two versions of this machine, one for machining bottle molds, one for forging dies. Supplied with 1, 2 or 4 cutter spindles.





Still Running Fine, BUT

TODAY'S KELLERS WILL BRING EVEN GREATER PROFITS.

You may put off replacing an older machine because "it's still paying its way." But is it? A machine tool purchased years ago may be the cause of lost efficiency, higher labor and per-unit costs, the inability to produce high quality economically. Failure to compete profitably with more modern machines may be putting you far behind your competitors. For example, just 10 short years ago our Keller BG-2 Tracer-Controlled Miller was the ultimate in productive efficiency, but let's check the added features possessed by its successor, the new P&W BG-22 Keller . . .

- 1. Operates from any conventional polyphase current, with no motor generator set required.
- 2. Increased travel speed of cutting tool . . . to an infinitely variable range from 0.5 to 30.0 inches per minute.
- Three dimensional tracer permits motion in 2 directions at the same time, yet allows interlocking action for accuracy. One slide is kept always in motion, while the second moves as required to follow the shape and maintain accurate interlocking action.
- More nearly perfect surface cutting speed over irregular contours assured through superimposed auto-speed control of all motions.
- Increased capacities . . . up to 20 feet horizontal x 7 feet vertical.
- Centralized operator controls supplemented by remote control stations.
- 7. Rapid traverse in all three motions.
- 8. Automatic lubrication.
- Score-proof phenolic bearing surfaces on all slides and lead screw nuts.

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MACHINE TOOLS . GAGES . CUTTING TOOLS

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When a bomber is designed for supersonic speeds as well as altitudes above 50,000 feet the combination of weight and strength becomes vitally important.

That's why Convair uses honeycomb "sandwich" construction for wing and fuselage panels. In producing these panels, honeycomb sections are placed in frames, faced with a silver-manganese alloy brazing foil, and then covered with skins. (Honeycombs, end closures, frames and skins are all of stainless steel.)

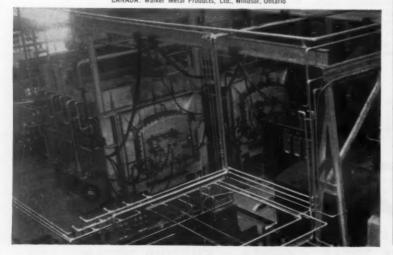
Assemblies are then loaded into a large alloy retort mounted on a furnace car and then travel through a brazing fumace installation designed and built by Holcroft. The result is a complete bond of all stainless steel parts.

Many manufacturers are taking a tip from the aircraft industry and are applying honeycomb construction to their own products. And more and more of these manufacturers are turning to Holcroft—not only for help in developing brazing systems but for all heat treating answers as well. You can, too. Just write.

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Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

BORING HEADS

BORING HEADS

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Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Heald Machine Co., 10 New Bond St., Worcester 6, Moss.
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Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
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Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale. Milch. Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

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Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio.
Boldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., Bridgeport 6, Conn.
Burg Tool Mfg. Co. Inc., Gardena, Colif.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
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Evileg Machine Co., Ferndale, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, III.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukana, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Moline Tool Co., Moline, III.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., Lansing, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pope Machinery Co., Haverhill, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Tool & Engrg. Co., 3400 E. Lafayette St., Detroit 9, Mich.
Wadles Equipment Co., Clark, N. J.
Wales-Strippit Co., Akron, N. Y.

BORING MILLS, Horizontal

BORING MILLS, Horizontal

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Bullard Co., Bridgeport 6, Conn.
Cincinnati Gilbert Machine Tool Co., 3366
Beekman St., Cincinnati 23, Ohio.

Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N.Y.

Cosa Corp., 405 Lexington Ave., New York 17
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

G & Land Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, III.

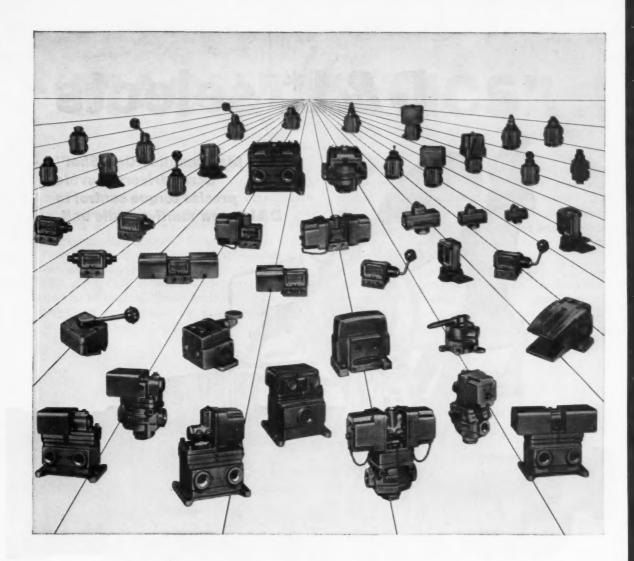
Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio.

New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

Portage Machine Co., 1025 Sweitzer Ave., Akron 11, Ohio.

Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

(Continued on page 308)



These valves like tough jobs

Discriminating engineers are finding that out. More and more of them are specifying Hannifin valves for every kind of directional air control—including the really tough jobs.

There are plenty of reasons why: Inspired simplicity of design. Fewer parts—and those easily and quickly

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AIR CONTROL

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VALVES

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D&L* selects

Magnamatic "One-Shot" Screwdrivers provide precise torque control in D&L's new multi-spindle unit.

D&L TOOL AND MACHINE COMPANY*

990 S. Oakwood, Detroit 17

Manufacturers of automatic single and multi-spindle screwdrivers and nutrunners for automation assembly lines.

306-MACHINERY, July, 1957

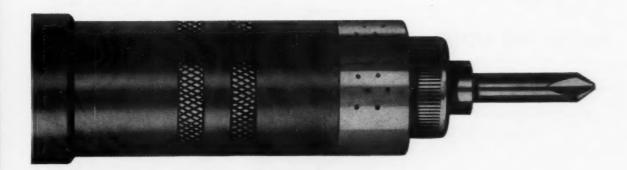
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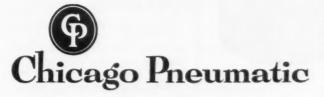
impacting to cause jaw wear... the absence of ratcheting means consistent torque settings that don't need readjustment; the absence of impacting means longer bit life, and no possibility of burred screw heads, stripped threads, or sheared fasteners... air line pressure variations don't affect delivered torque... torque output can be changed to suit job requirements.

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King Mochine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Portage Mch. Co., 1025 Sweitzer Ave., Akron 11, Ohio

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Triplex Machine Tool Corp., 75 West St., New York 6, N. Y.

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Apex Tool & Cutter Co., Inc., 285 Canal St., Shelton, Conn.
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Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park, Annex Detroit 32, Mich.
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Petroit Broach Co., Inc., 950 S. Rochester Rd.,
Rochester, Mich.
duMont Corp., Greenfield, Mass.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
32, Mich.
Lapointe Mch. Tl. Co., Tower St., Hudson,
Mass. 32, Mich.
Lapointe Mch. Tl. Co., Tower St., Hudson,
Mass.
Metallurgical Products Dept. of General Electric Co., Box 237 Roosevelt Park Annex,
Detroit 32, Mich.
National Broach & Mch. Co., 5600 St. Jean
Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St.,
Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd.,
Ferndale, Mich.

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American Broach & Mch. Co., Ann Arbor, Mich.
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Detroit Broach Co., Rochester, Mich.
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Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio.
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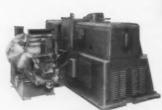
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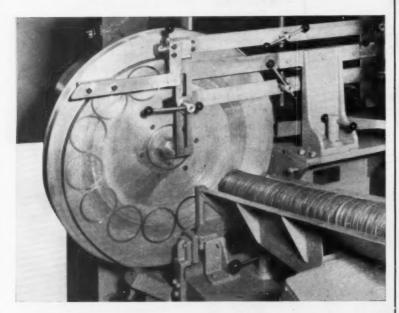


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Sundstrand Mch. Tool Co., 2531—11th St.,
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Wesson Co., 1220 Woodward Heights Blvd.
Ferndale, Mich.

CASTINGS, Die

American Brass Co., Waterbury 20, Conn. Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous

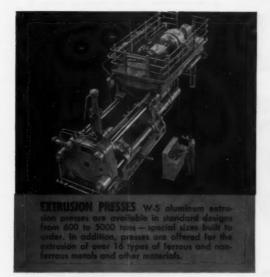
American Crucible Products Co., Loraln, Ohio. Bethlehem Steel Co., 701 East Third St., Bethlehem Sreet Co., 797 Business Bethlehem, Pa.
Centrifugally Cast Products Div.—Shenango Furnoce Co., Denver, Ohio.
Dow Chemical Co., Midland, Mich.
Mueller Brass Co., Port Huron 35, Mich.
Vascoloy-Ramet Corp., Waukegan, III.

CASTINGS, Gray Iron, Malleable

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa. Centrifugally Cast Products Div.—Shenango Furnace Co., Dover, Ohio. Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio Ohio.
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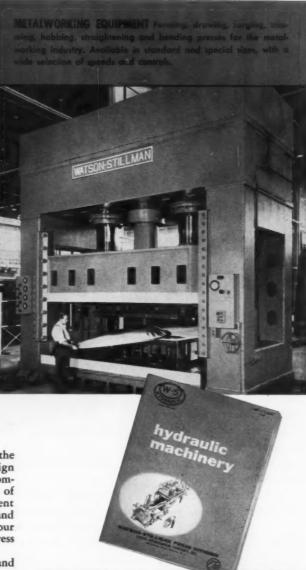
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Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

CERAMIC TOOL MATERIAL-See Tool Material. Ceramic

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Cone Automatic Mch. Co., Inc., Windsor, Vt.
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Mich.
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Mch. Div., New Britain, Conn.
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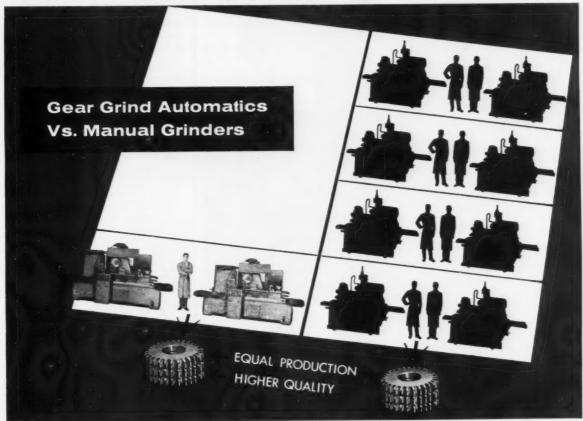
Olotsson Corp., 2/29 Lyons Ave., Lansing, Mich. Pratt & Whitney Co., Inc., West Hartford, Cann. Warner & Swasey, 5701 Carnegie Ave., Cleve-land 3, Ohio. Wickes Brothers, 512 No. Water St., Saginaw, Mich.

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(Continued on page 314)

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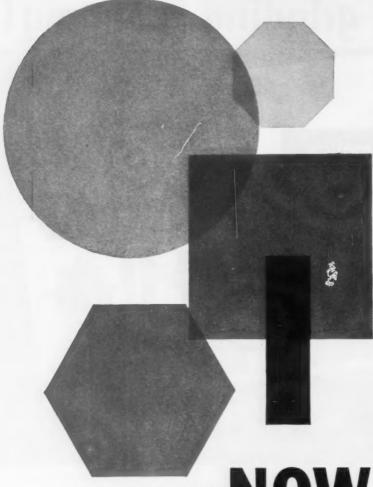
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Cushman Chuck Co., Windsor Ave., Hartford 2, Conn.

Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.

Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.

Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.

Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

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Bryant Chucking Grinder Co., Clinton St., Springfield, Vt. Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio Cushman Chuck Co., 800 Windsor St., Hartford 2. Conn.
Pittsburgh 8, Pa. Errington Mech. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y. Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis. Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis. Hardinge Bross, Inc., 1420 College Ave., Elmira, N. Y. Jacobs Mfg. Co., West Hartford 10, Conn. Kearney & Trecker Corp., Milwaukee 14, Wis. National Acme Co., 170 E. 131st St., Cleveland 8, Ohio New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn. South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind. Universal Engrg. Co., Frankenmuth 2, Mich. Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Combination Universal-Inde-pendent

pendent
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New
Britain, Conn.

CHUCKS, Compensating

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CHUCKS, Diaphragm

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt. Wadell Equip. Co., Terminal Ave., Clark, N. J.

CHUCKS, Drill, Key Type
Delta Power Tool Div., 400 Lexington Ave.,
Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa. Jacobs Mfg. Co., West Hartford, Conn. Scully-Jones & Co., 1906 Rockwell St., Chicago 8, III.

(Continued on page 316)

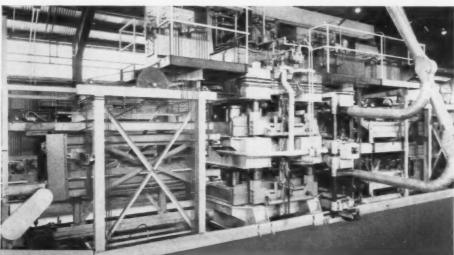
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CHUCKS, Full Floating

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CHUCKS, Gear

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt. Cushman Chuck Co., 808 Windsor St., Hart-ford 2, Conn. Horton Chuck, Windsor Locks, Conn. Le Maire Tool & Mfg. Co., Dearborn, Mich.

CHUCKS, Independent

Cushman Chuck Co., 806 Windsor St., Hart-ford 2, Conn. Gisholt Mch. Co., Madison 10, Wis. Homestrand, Inc., Larchmont, N. Y. Horton Chuck, Windsor Locks, Conn. Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathes, etc.

CHUCKS, Lathes, etc.

Axelson Mfg. Co., 6160 S. Boyle Ave., Los.
Angeles 58, Cal.

Bullard Co., Brewster St., Bridgeport 2, Conn.
Cushman Chuck Co., Windsor Ave., Hartfard 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St.,
New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New
Britain, Conn.
South Bend, Lathe Works, Inc., 425 E. Madison
St., South Bend, Ind.
Standard Tool Co., 3950 Chester Ave., Cleveland, Ohio.

Warner & Swasey Co., 5701 Carnegie Ave.,
Cleveland 3, Ohio.

CHUCKS, Magnetic

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, III.
Hanchett Magna-Lock Corp., Big Rapids, Mich.
Sundstrand Mch. Tool Co., 2531 11th St.,
Rockford, III.
Walker, O. S., Inc., Worcester, Mass.

CHUCKS, Power Operated

Cushman Chuck Co., 806 Windsor St., Hart-ford 2, Conn. Gisholt Mch. Co., Madison 10, Wis. Logansport Mch. Co., Inc., Logansport, Ind. Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

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Universal Engineering Co., Frankenmuth 2. niversal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn. Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping

DoAll Co., 254 N. Laurel Ave., Des Plaines, III. Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y. Jacobs Mfg. Co., West Hartford, Conn.

Scully-Jones & Co., 1903 Rockwell St., Chi-cago 8, III. Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Universal Three-Jaw

CHUCKS, Universal Three-Jaw
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 Lexington Ave.,
Pittsburgh 8, Po.
Gisholt Mch. Co., Madison 10, Wis.
Homestrand, Inc., Larchmont, N. Y.
Horton Chuck, Windsor Locks, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New
Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless

Gisholt Mch. Co., Madison 10, Wis.

CIRCUIT-BREAKERS

General Electric Co., Schenectady 5, N. Y.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment Spacing Equipment

CLEANERS, Metal

Oakite Products, Inc., 19 Rector St., New York, N. Y.

CLUTCHES

Cleveland Punch & Shear Works, Co., 3917 St. Clair Ave., Cleveland 14, Ohio. Dynamatic Div. Eaton Mfg. Co., Keno;ha, Wis. Fawick Corp., Cleveland, Ohio Minster Mch. Co., Minster, Ohio. Rockford Clutch Div., Rockford, III.

COLLETS-See Chucks, Collet

COMBINATION SQUARES—See Machinists' Small Tools

COMPARATORS, Dial, Electronic and

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Federal Products Corp., 1144 Eddy St., Providence I, R. I.
Hanson-Whitney Co., 169 Bartholomew Ave.,
Hartford 3, Conn. (dial, thread)
Sheffield Corp., Box 893, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

COMPARATORS, Optical

Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., 254 Laurel Ave., Des Planes, III.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New
York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St.,
New York 12, N. Y.

COMPOUNDS, Cleaning—See Cleaners,

COMPOUNDS, Cutting, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

COMPRESSORS, Air

Chicago Pneumatic Tool Co., New York 17, N. Y. Ingersoil-Rand Co., 11 Broadway, New York 4, N. Y. Wilson, K. R., Inc., Arcade, N. Y.



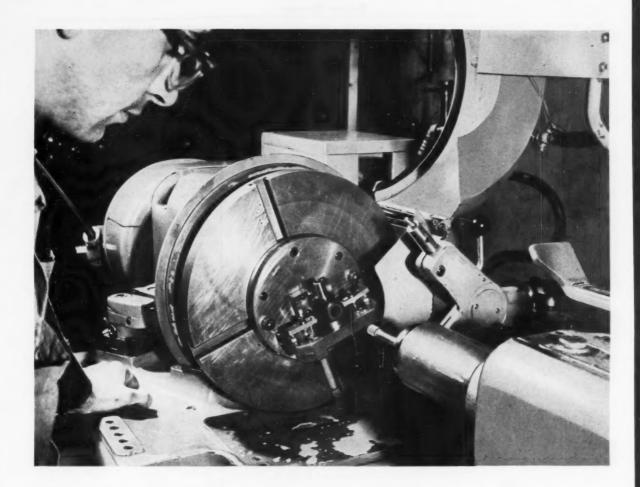
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316—MACHINERY, July, 1957



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MACHINERY, July, 1957-317



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Bliss, E. C., Co., 1375 Raff Rd., S. D., Canton, Ohio. Ohio.

Ohio.

Ohio.

Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.

Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.

Hartford Special Machinery Cc., 287 Homestead St., Hartford, Conn.

Kearney & Trecker Corp., Milwaukee 14, Wis. Lake Erie Machinery Corp., 470 Woodward Ave., Butfalo 17, N. Y.

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Van Keuren Co., Watertown, Mass.

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Circular Tool Co., Inc., 765 Allens Ave.,
Providence S, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St.,
Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 120 Oakman Blvd., Detroit
32, Mich.
Hoynes Stellite Div., Union Carbide & Carbon
Corp., 30 E. 42nd St., New York
Heller Tool Co., Newcomerstown, Ohio
National Twist Drill & Tool Co., Rochester,
Mich.
Scully-Jones & Co., 1906 Rockwell St., Chicago
8, Ill.
Trep & Die Co., 16 Arch St., 8, III.
Threadwell Tap & Die Co., 16 Arch St.,
Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd.,
Detroit 20, Mich.
Whitman & Barnes, 40600 Plymouth Rd.,
Plymouth, Mass.

COUNTERS

Starrett, The L. S., Co., Athol, Mass.

COUPLINGS

COUPLINGS
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. C., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Philadelphia Gear Works, Erle Ave., and G Sts., Philadelphia, Pa.
Schrader's Sons, A., 470 Vanderbilt Ave.,
Brooklyn 38, N. Y.
Standard Pressed Steel Co., Jenkintown, Pa. (Shaft)
Thor Power Tool Co., 175 N. State St., Aurora,
Ill.
Walker Co., Inc., O. S., Rockdale St.. Worces-Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

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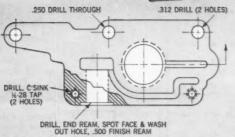
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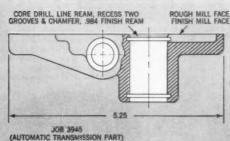




on this 12-station

KINGSBURY





This central column Kingsbury has 13 units which operate 19 spindles. A loading assembly positions the work (an automatic transmission part) for clamping by an air-actuated mechanism. Two vertical units with adjustable arbors mill the joint face; a recessing unit works on the snap ring grooves. Thirteen tools have guide bushings. Finish reaming is done last, after the heavier operations are completed. Indicator lights signal the operator if any operations are unfinished.

Most Kingsburys are less elaborate. But all have the same purpose:

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CUTTERS, Milling Apex Tool & Cutter Co., Inc., 235 Canal St., Shelton, Conn. Barber-Colman Co., 1300 Rock St., Rockford, Snetron, Conn.
Sorber-Colman Co., 1300 Rock St., Rockford, III.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St.,
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DoAll Co., Des Plaines, III.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
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Goddard & Goddard Co., Detroit, Mich.
Gorton, George, Mch. Co., 1321 Racine St.,
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Hanson-Whitney Co., 169 Bartholomew Ave.,
Hartford 3, Conn. (dial, thread)
Haynes Stellite Co., Kokomo, Ind.
Ingersoll Milling Mch. Co., 2442 Douglas St.,
Rockford, III.
Kearney & Trecker Corp., Milwaukee, Wis.
Kennametal, Inc., Latrobe, Pa.
Lovejoy Tool Co., Inc., Springfield, Vt.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex,
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National Twist Drill & TI. Co., Rochester,
Mich.
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Tomkins-Johnson Co., Jackson, Mich.
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Cincinnari 9, Ohio
Citles Service Oil Co., 70 Pine St., New York, N. Y.
DoAll Co., Des Plaines, Ill.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sincialir Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa. Texas Co., 135 E. 42nd St., New York, N. Y.

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Modern Machine Tool Co., Jackson, Mich.

CUTTING-OFF SAWS, Abrasive Wheel

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, III.
Norton Co., 1 New Bond St., Worcester 6, Mass. Mass. Simonds Abrasive Co., Tocony & Fraley Sts., Philadelphia 35, Pa. Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, III.

CUTTING TOOLS—See Tool Material

CYLINDERS, Air

Cushman Chuck Co., 806 Windsor St., Hart-ford 2, Conn. Hannifin Corp., 501 Wolf Rd., Des Plaines, Ill. Hydraulic Press Mfg. Co., Mt. Gilead, Ohio Logansport Mch. Co., Inc., Logansport, Ind. Tomkins-Johnson Co., Jackson, Mich.

CYLINDERS, Hydraulic

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Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Logansport Machine Co., Inc., Logansport, Ind.
Oildear Co., 1569 W. Pierce St., Milwaukee
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Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio

Sheffield Corp., Box 893, Dayton 1, Ohio

Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, III.

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DIE CASTINGS-See Casting, Die

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DIE CUSHIONS

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Clearing Mch. Corp., 6499 W. 65th St., Chi-Clearing Mch. Corp., 6479 Tr. Colin Ing. cago, III. Danly Mch. Specialties, Inc., 2100 S. Laramie, Chicago 50, III. Dayton Rogers Mfg. Co., Minneapolis, Minn. Federal Machine & Welder Co., Overland Ave., Warren, Ohio
Warren, Ohio
Minster Mch. Co., Minster, Ohio
Verson Altsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, III.

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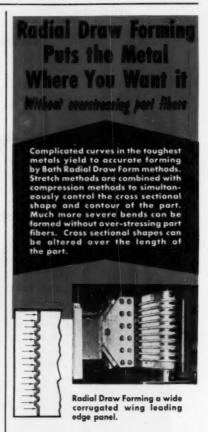
Pratt & Whitney Co., Inc., West Hartford,

DIE INSERTS, Carbide

Allegheny Ludium Steel Corp., Pittsburgh, Pa Kennametal Inc., Latrobe, Pa. Metallurgical Products Dept. of General Elec-tric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich. Vascoloy-Ramet Corp., Waukegan, III.

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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohia Danly Mch. Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill., Producto Mch. Co., 985 Housatonic Ave., Bridgeport 1, Conn. U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Wales-Strippit Co., Akron, N. Y.



Sketch illustrates complete confinement and control of part cross section at point of bend while part is being stretch formed.





Forming a Z shaped guided missile part to contour by the Radial Draw Form method.

While the part is stretched to contour, compression shoe forces at the point of bend assist with contour formation and assure accurate angularity and flatness in the cross section of the part.



(LOCATED IN THE GREATER CLEVELAND AREA) Manufacturers of Radial Draw Formers • Dies • Tools Press Brakes • Tangent Bending Sequence Presses • Press Type Brakes • Special Machines

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RADIAL DRAW FORMERS

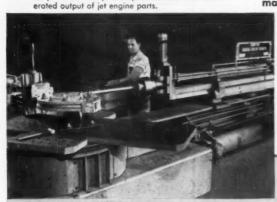


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AT RYAN, Bath CF 25-35 turns out fuselage sections

for jet tanker and jet transports as well as an accel-

AT NORTH AMERICAN, Columbus, Model CF 25 Bath Radial Draw Former produces a variety of changing angle curves for the F-100D Super Sabre.

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Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.
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Wales-Strippit Corp., North Tonawanda, N. Y.

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Jones & Lamson Mch. Co., Springfield, Vt. Landis Mch. Co., Waynesboro, Pa. National Acme Co., 170 E. 131st St., Cleve-land, Ohio

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DIES, Thread Rolling

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Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.

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Hoglund Eng. & Mrg. Co., His., School, N. J.
N. J.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex,
Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave.,
Bridgeport, Conn.
Norton Co., I New Bond St., Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford,
Conn. Conn. Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y. Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

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Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Buffalo Forge Co., Broadway, Buffalo, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich. (Continued on page 326)

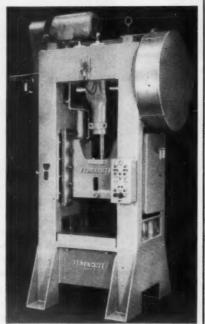
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Ferracute Press \$-1-150-27-33, 150 tons

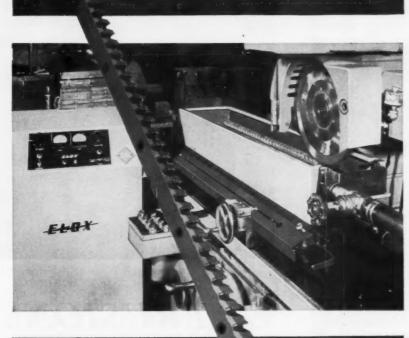
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Broach, used for broaching the pine tree form on turbine blades of the J-57 Jet engine.

NO DIAMOND WHEEL...

EDM substitutes inexpensive brass wheels costing less than \$45 for expensive diamond wheels costing a minimum of \$150. Brass wheels are formed for \$1 as against a diamond wheel contour forming cost of \$35.

NO PREFORMED CARBIDE BLANKS ...

Conventional machining necessitates preformed tungsten carbide and preformed steel shanks. EDM machines the carbide, brazing material and steel simultaneously, and requires no indexing to assure a perfectly formed broach as to location and size.

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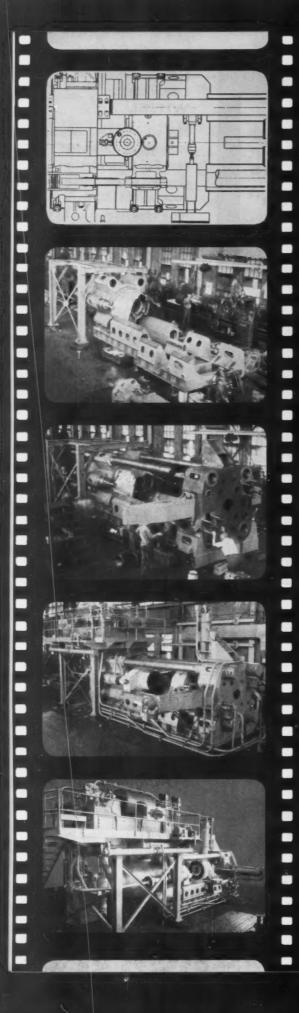
Conventionally machined, the pine tree broach requires 22 operations. EDM does it better in 14.

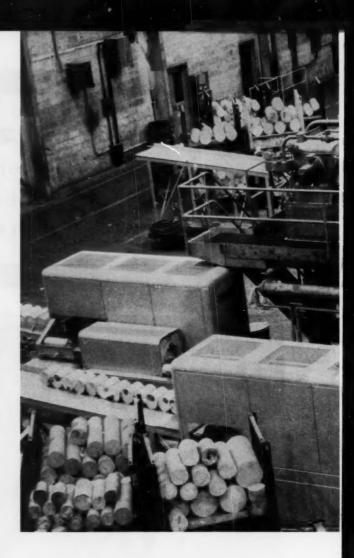
Electrical Discharge Machining has reduced the machining time of this intricate form in 32 carbide tipped teeth to a total time cycle of 33 minutes . . . onehalf the time of abrasive grinding. Tolerances held to: +0, -.0002".

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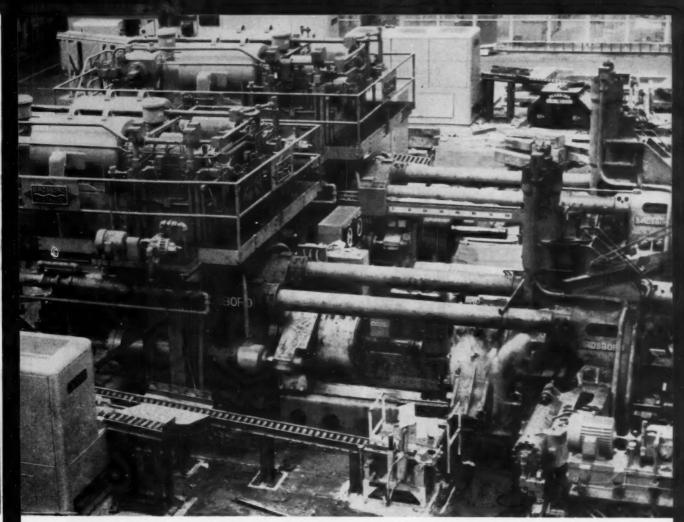




EXTRUSION... gets big boost

• At each step in design and building of Extrusion Presses, Birdsboro has found new ways to add production economies in the fast-moving extrusion industry. From the blueprint stage through construction, special engineering advances make extra savings possible. In time for instance: 15 to 20 minutes per die change is saved through special transverse die slide; also, dead cycle time is reduced 20 seconds. These are just samples of advances made in a recent Birdsboro installation at Kaiser Aluminum's Halethorpe plant.

Here are a few of many stages from blueprint to assembly in the construction of the extrusion presses pictured above.



Modern, self-contained, oil hydraulic four-column aluminum extrusion presses designed and built by Birdsboro for Kaiser Aluminum's plant in Halethorpe, Md.

.. Metalworking's fastest growing method from **BIRDSBORO** engineering

Here are details as reported in "Kaiser Aluminum NEWS":

"Four new presses, costing over \$1,000,000 have been built for us by Birdsboro Steel Foundry and Machine Company. Three of them are 2,750-ton, self-contained, oil hydraulic presses 34½ feet long, 14½ feet high. They are engineered to make extruded shapes from billets of 8 to 12 inches in diameter and up to 32 inches in length. In shipping each press, it took five railroad cars to carry the load.

"Heaviest new unit in the line is a 3,500-ton water hydraulic press, also built by Birdsboro."

Birdsboro can supply any type of hydraulic press, including 1,000 to 12,000-ton presses for extruding aluminum, magnesium, copper, titanium, brass and steel. A call to Birdsboro now may mean important design advantages for you in your next press order. Main office and plant: Birdsboro, Pa., Subsidiary: Engineering Supervision Co., 120 W. 42nd St., New York 36, N. Y. District Office: Pittsburgh, Pa.



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Ettca Tool Co., Inc., 594 Johnson Ave., BrookIyn, N. Y.

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National Automatic Tool Co., Richmond, Ind. Snyder Tool & Engrg. Co., 3400 Lafayette, De-troit 7, Mich.

Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.

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(Continued on page \$29)

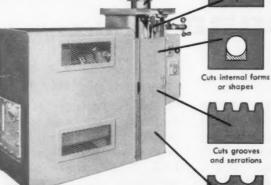
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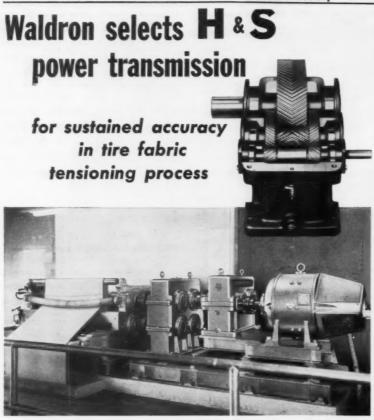
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(Continued on page 330)

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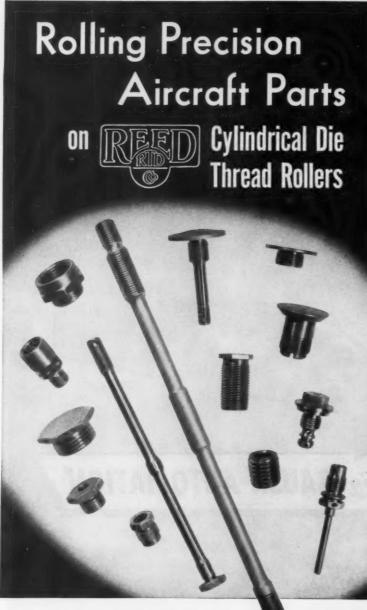
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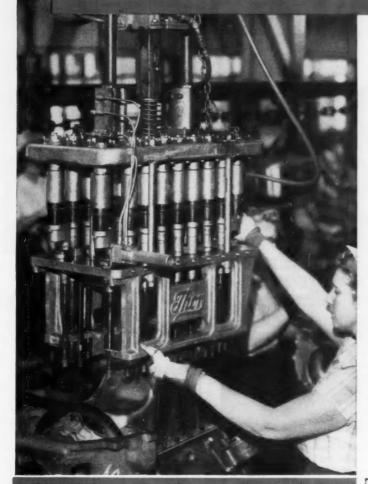
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Buffalo Forge Co., 490 Broadway, Buffalo,

FEEDERS, Automatic

Perry Equipment & Eng. Co., Erie, Penna. Production Feeder Corp., Mentor, Ohio V & O Press Co., Hudson, New York

FILES, Band

DoALL Co., Des Plaines, III.

FILES, General-purpose, Swiss Pattern

DoALL Co., Des Plaines, III. Heller Tool Co., Newcomerstown, Ohio Simonds Saw & Steel Co., 470 Main St., Fitch-burg, Mass.

FILES AND BURRS, Rotary

DOALL Co., Des Plaines, III.
Heller Tool Co., Newcomerstown, Ohio
Pratt & Whitney Co., Inc., West Hartford,
Conn.
Severance Tool Ind., Inc., Soginaw, Mich.
Simonds Saw & Steel Co., Fitchburg, Mass.
Wesson Co., 1220 Woodward Heights Blvd.
Ferndale, Mich.

FILING MACHINES

Chicago Pneumatic Tool Co., New York 17, N. Y. N. Y.
DOALL Co., Des Plaines, III.
Oliver Instrument Co., 1410 E. Maumee St.,
Adrian, Mich.

FILTERS, Coolant and Oil

Barnes Drill Co., 814 Chestnut St., Rockford, III.
Commercial Filters Corp., Lebonon, Ind.
Industrial Filtration Co., 15 Industrial Ave.,
Lebanon, Ind.
Marvel Engineering Co., 7227 N. Hamlin Ave.,
Chicago 45, III.

FINISHES, Machine and Metal

Lowe Bros. Co., Dayton, Ohio

FLAME-HARDENING MACHINES

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FORGING HAMMERS, Steam and Air

Chambersburg Engrg. Co., Chambersburg, Pa.

FORGING MACHINES, Headers, Upsetters, Presses

Ajax Mfg. Co., Euclid. Cleveland 17, Ohio Bliss, E. W. Co., 1375 Raff Rd. S. W., Can-ton, Ohio Hill Acme Co., 1201 W. 65th St., Cleveland 2. Ohio Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y. National Machinery Co., Tiffin, Ohio

FORGINGS, Drop

FOKGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Crucible Steel Co. of America Henry W. Oliver Bldg., Mellon Square, Fitsburgh 22, Pa. Mueller Brass Co., Port Huron 35, Mich. Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Hollow-Bored

Bethlehem Steel Co., 701 East Third St., Beth-lehem, Pa. Mueller Brass Co., Port Huron, Mich.

FORGINGS, Press

Bethlehem Steel Co., 701 East Third St., Beth-lehem, Pa. Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio Minster Mch. Co., Minster, Ohio Mueller Brass Co., Port Huron, Mich. (Continued on page 336)







Mr. Richard H. Aufderheide, President and Production
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New Departure Div., Bristol, Conn.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FORMING MACHINES, Cold-rolling

Ferrocute Machine Co., Bridgeton, N. J. Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Hartford Special Machinery Co., 287 Home-stead Ave., Hartford, Conn. Hydraulic Press Mfg. Co., Mount Gilead, Ohio Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y. Yoder Co., 5500 Walworth, Cleveland, Ohio

FORMING MACHINES, Multiple-slide

Baird Machine Co., 1700 Stratford Ave., Strat-ford, Conn.
Baldwin-Lima-Hamilton Corp., Lima-Hamilton Div., Hamilton, Ohio Bliss, E. W. Co., 1375 Raff Rd., S. W., Can-Bliss, E. W. Co., 1373 Res., 1375 Clearing Machine Corp., 6499 W. 65 St., Chicago 38, III.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Dreis & Krump Mfg. Co., 7416 Loomis Blvd., Chicago 36, III.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn. U. S. Tool Co., Inc., 255 North Main St., Ampere, N. J.

FORMING TOOLS or Tool Blanks

Brown & Sharpe Mfg. Co., Providence, R. I. Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York Kennametal, Inc., Latrobe, Pa. National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich. Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FURNITURE, Shop

Standard Pressed Steel Co., Jenkintown, Pa.

GAGE BLOCKS

Brown & Sharpe Mfg. Co., Providence, R. I. Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill. Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St.,
New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd.,
Chicago 12, III.

GAGES, Automatic Sorting

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.

Thread, Groove, etc.
Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfq. Co., Providence, R. I.
Bryant Chucking Grinder Co., Clinton St.,
Springfield, Vt.
Comtor Co., 47 Farwell St., Waltham 54, Mass.
Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
DOALL Co., Des Plaines, III.
Federal Products Corp., 1144 Eddy St., Providence I, R. I.
Lufkin Rule Co., Saginaw, Mich.
Scherr, George Co., Inc., 200 Lafayette St.,
New York 12, N. Y.
Size Control Co., 2500 W. Washington Blvd.,
Chicago 12, III.
Starrett, The L. S., Co., Athol, Mass.

GAGES, Electric Comparator

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, III.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
General Electric Co., Schenectady, N. Y.
Pratt & Whitney Co., Inc., West Hartford, Conn. Sheffield Corp., Box 893, Dayton 1, Ohio Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.

GAGES, Grinding

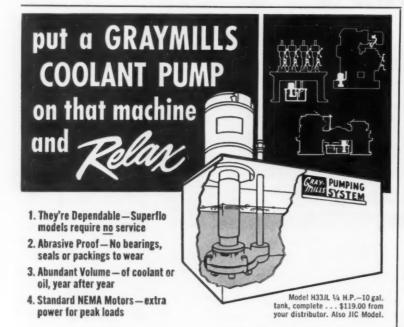
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper, Telescoping Thickness Brown & Sharpe Mfg. Co., Providence, R. I.

GAGES, Multiple Inspection Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn. Sheffield Corp., Box 893, Dayton 1, Ohio

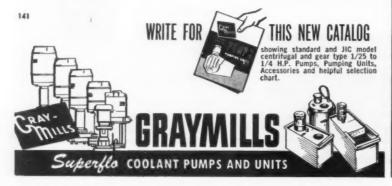
GAGES, Plug and Ring

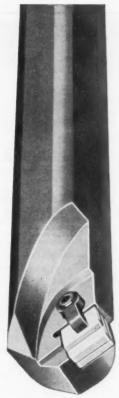
Brown & Sharpe Mfg. Co., Providence, R. I Dearborn Gage Co., 22038 Beech St., De born, Mich. DoAll Co., Des Plaines, III. (Continued on page \$58)



Yes, you'll get smooth, steady performance, at less cost, with Graymills pumps or units for original equipment, replacement or conversion. That's why more and more machine tool builders are using Graymills. You'll like the personal services too, they are sold by leading Industrial Distributors and Graymills representatives near you are ready to help with special problems. Specify "GM" pumps-install 'em-forget 'em-relax!

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Square insert, 15degree lead angle. Suitable for most boring operations.



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With the proper grade of Kennametal* "throw-away" inserts, bars can be used for both rough and finish boring of pieces up to several inches in diameter. Almost all boring operations can be handled with only two bars. Special designs are available for special jobs.

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OFFER THESE PRODUCTION BENEFITS

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Prott & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio Size Control Co., 2500 W. Washington Blvd., Chicago 12, III.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., Watertown, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Pressure, Air and Hydraulic

Modern Industrial Eng. Co., 14230 Birwood Ave., Detroit 38, Mich.

GAGES, Roll Thread Snap, Adjustable Snap

Shap
Federal Products Corp., 1144 Eddy St., Providence J. R. I.
Greenfield Top & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton I, Ohio
Size Control Co., 2500 W. Washington Blvd.,
Chicago 12, III.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

field, Mass.

GAGES, Surface Roughness

DoAll Co., Des Plaines, III. Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth

Brown & Sharpe Mfg. Co., Providence, R. I. DoAll Co., Des Plaines, III. Federal Products Corp., 1144 Eddy St., Providence J. R. I. Starrett Co., L. S., Athol, Mass.

GASKETS

Garlock Packing Co., Palmyra, N. Y.

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Fellows Gear Shaper Co., Springfield, Vt. Gleason Works, 1000 University Ave., Roches-ter 3, N. Y. Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Po. Cross Co., 3250 Bellevue Ave., Detroit 7, Mich. Gleason Works, 1000 University Ave., Roches-ter 3, N. Y. Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich. Orban, Kurt Co., Inc., 42 Exchange Place, Jer-sey City 2, N. J. Sheffield Corp., Box 893, Dayton 1, Ohio

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GEAR CHECKING EQUIPMENT
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Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd.,
Detroit 12, Mich.
Notional Broach & Mch. Co., 5600 St. Jean
Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place,
Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St.,
New York 12, N. Y.

GEAR CUTTING MACHINES Bevel and Spiral

Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn. Orban, Kurt Co., Inc., 42 Exchange Place, Jer-sey City 2, N. J. Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels

Barber-Colman Co., 1300 Rock St., Rockford, III.
Cone Drive Gear Div., 7171 E. McNichols Rd.,
Detroit 12, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut
Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St.,
New York 12, N. Y.

GEAR GRINDERS-See Grinding Machines, Gear

GEAR HOBBERS

American Schiess Corp., 1232 Penn Ave., Pitts-burgh 22, Pa. Barber-Colmon Co., 1300 Rock St., Rockford, Cosa Corp., 405 Lexington Ave., New York Fellows Gear Shaper Co., Springfield, Vt. Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio Ohio
Michigan Tool Co., 7171 E. McNichols Rd.,
Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

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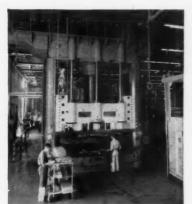
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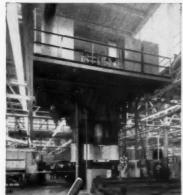
1100 ton press at Los Angeles



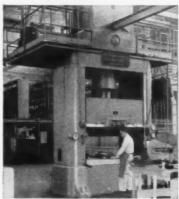
1000 ton press at Los Angeles



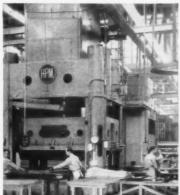
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7000 ton press at Columbus, Ohio



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National Broach & Mch. Co., 5600 St. Jean,
Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GEAR MOTORS-See Speed Reducers

GEAR RACKS

GEAR KACKS

Gear Specialties, Inc., 2635 W. Medill A.e.,
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Illinois Gear & Mch. Co., 2108 No. Natchez
Ave., Chicago 35, III.

Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

Stahl Gear & Mch. Co., The, 3901 Hamilton
Ave., Cleveland 4, Ohio

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Fellows Gear Shaper Co., Springfield, Vt. Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Nonmetallic

Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendarf Gear Corp., Box 934, Syracuse, N. Y.

Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, III.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Illinois Gear & Mch. Co., 2108 No. Natchez
Ave., Chicago 35, III.
New Jersey Gear & Mfg. Co., Hillside, N. J.
Philadelphia Gear Works, Erie Ave. and G St.,
Philadelphia, Pa.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, III.
Stahl Gear & Mch. Co., 3901 Hamilton Ave.,
Cleveland 14, Ohio

GEARS, Cut

GEARS, Cut

Automotive Gear Works, Inc., South 8th &
O St., Richmond, Ind.
Bilgram Gear & Mch. Works, 1217-35 Spring
Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy
71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Cone Drive Gear Div., 7171 E. McNichols Rd.,
Detroit 12, Mich.
Diefendorf Gear Corp., Box 934, Syracuse,
N. Y. Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Pairfield Mfg. Co., 2309 S. Earl Ave., Lafayette, Ind.
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio
Illinois Gear & Mch. Co., 2100 No. Natchez Ave., Chicago 35, Ill.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N., 2011, 1470 Chestnut Ave., Hil Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa.
Stahl Gear & Mch Co., 3901 Hamilton Ave.,
Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, III.

GENERATORS, Electric

Allis-Chalmers Mfg. Co., Milwaukee, Wis. General Electric Co., Schenectady, N. Y. Reliance Electric & Engrg. Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

GRADUATING MACHINES

Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES-See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa. Jones & Lamson Mch. Co., Springfield, Vt. Mummert-Dixon Co., Hanover, Pa. National Acme Co., 170 E. (31st St., Cleveland 8, Ohio South Bend Lathe Works, South Bend 22, Ind. Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio Thor Power Tool Co., 175 N. State St., Aurora, III. U.

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GRINDERS, Carbide Tool

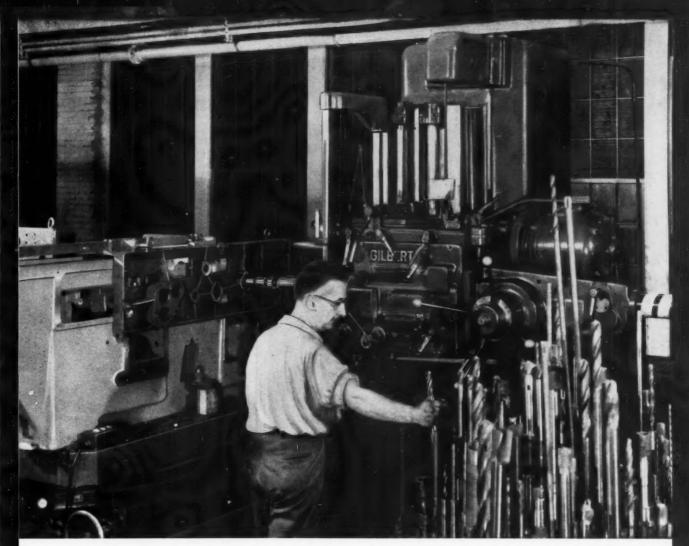
GRINDERS, Carbide Tool
Arter Grinding Mch. Co., 15 Sagamore Rd.,
Worcester 5, Mass.
Delta Pawer Tool Div., 400 N. Lexington Ave.,
Pittsburgh, Pa.
Elox Corp. of Mich., Royal Oak 3, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
32, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex,
Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6,
Mass. Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6,
Mass.
Oliver Instrument Co., 1410 E. Maumee St.,
Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2488-90 River
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Wesson Co., 1220 Woodward Heights Blvd.,
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courtesy Brown & Sharpe Mfg. Co.

Brown & Sharpe cuts time 75% with Gilbert boring mill

"The handling time on this job has been reduced by 75% and the machining time has been reduced by 40%," says T. R. Buckles, Equipment Engineer for Brown & Sharpe Mfg. Co.

These profitable savings were earned by fitting a Cincinnati Gilbert boring mill with a Gilbert revolving table, adjustable on runway, and traveling tool holder designed by Brown & Sharpe.

There are about 180 holes in the workpiece. The boring mill performs drilling, reaming, tapping, or

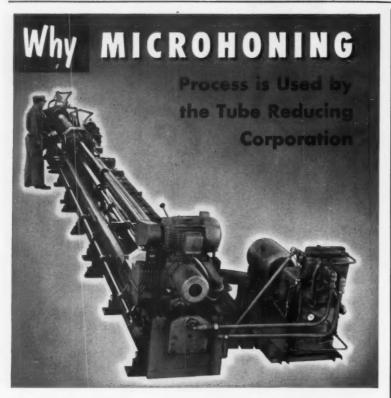
boring operations as well as some milling cuts. The job was formerly done on a radial drill, portable drill, and floor type miller.

This is another typical example of the time saved (and profits earned) by Cincinnati Gilbert horizontal boring mills. Our man will be glad to show you more examples.

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Low-cost financing plan-8% simple interest (4%% add on), up to 5 years to pay-makes your purchase of Gilbert equipment immediately feasible.

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Other "Rockrite" tubes, used in such applications as hydraulic cylinders, are Microhoned after "rocking" to generate final bore size and geometric

The principles and application of Microhoning are explained in a 30-minute, 16mm, sound movie, "Progress in Precision"... available at your request.

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GRINDERS, Drill Point

GRINDERS, Drill Point

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Milch.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.

Delta Power Tool Div., 400 N. Lexington Ave., pittsburgh 8, Pa.

Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

GRINDERS, Face Mill
Kearney & Tracker Corp., Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park
Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St.,
Adrian, Mich.

GRINDERS, Knife and Shear

Hill Arme Co., 1201 W. 65th St., Cleveland 2, Ohio Mattison Machine Works, Rockford, III. Mummert-Dixon Co., Hanover, Pa. Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y. N. Y.
Ingersoll-Rand Co., 11 Broadway, New York
4, N. Y.
Standard Electrical Tool Co., 2488-90 River,
Cincinnati 4, Ohio
Thor Power Tool Co., 175 N. State St., Aurora,
III.

GRINDERS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y. Madison-Kipp Corp., Madison, Wis. Thor Power Tool Co., Aurora, III.

GRINDERS, Tap

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich. Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt. Rockford Die & Tool Wks., Inc., Rockford, III.

GRINDERS, Tool and Cutter

Arlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Barber-Colman Co., Rock and Montague, Rockford, III.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York
17, N. Y.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Po.
Elox Corp. of Mich., Royal Oak 3, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Ropids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Corton, Gev., Mch. Co., 1321 Racine St., Racine, Wis.
Homestrand, Inc., Larchmont, N. Y.
Landis Tool Co., Waynesboro, Po.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., I New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
South Bend Lathe Wks., South Bend 22, Ind.
Thompson Grinder Co., 1500 W. Main St.,

GRINDERS, Toolpost

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind. Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES-See Gages, Grind-

GRINDING MACHINES, Abrasive Belt

GRINDING MACHINES, Abrasive Belt
Delta Power Tool Div., 400 N. Lexington Ave.,
Pittsburgh 8, Pa. e.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland
2, Ohio
Mattison Mch. Works, Rockford, III.,
Standard Electrical Tool Co., 2488-90 River
Rd., Cincinnati, Ohio
Thor Power Tool Co., 175 N. State St., Aurora,
III.
Walls Sales Corp., 333 Nassau Ave., Brook-Walls Sales Corp., 333 Nassau Ave., Brook-lyn 22, N. Y.

GRINDING MACHINES, Broach

GRINDING MACHINES, Broach

Colonial Broach & Machine Co., P. O. Box 37.

Harper Sta., Detroit 13, Mich.

Gallmeyer & Livingston Co., 336 Straight,

S. W., Grand Rapids 2, Mich.

Lapointe Mch. Tool Co., 34 Tower St., Hudson, Mass.

National Broach & Mch. Co., 5600 St. Jean,

Detroit 13, Mich.

Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

Thompson Grinder, 1534 W. Main, Springfield,

Ohio

GRINDING MACHINES, Cam

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6,
Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Triplex Machine Tool Corp., 75 West St., New York 6, N. Y.
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Crankshaft

Landis Tool Co., Waynesboro, Pa. Norton Co., 1 New Bond St., Worcester 6, Mass. Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J. Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Cylindrical

Agron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y. York 12, N. Y.
Arter Grinding Mch. Co., 15 Sagamore Rd., Worcester 5, Mas.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati P, Ohio
Cosa Corp., 405 Lexington Ave., New York
17, N. Y.
Frauenthal Div., Muskegon, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.
W., Grand Rapids 2, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6,
Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio Mass. Sheffield Corp., Box 893, Dayton 1, Ohio Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio Van Norman Co., 2640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tools Div., 400 Lexington Ave.,
Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Works, Rockford, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J (Continued on page 344)

MICROHONING Generates Functional Surfaces in Long Tubing UNIVERSAL JOINT

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Microhoning tools have long abrasive sticks which cannot follow irregularities in the bore. The abrasive action removes high spots while generating required surface characteristics and accurate geometry. A universal joint, connecting the tool body to the drive shaft, eliminates any tendency of abrasive action to change the bore location.

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y. Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich. Gleason Works, 1000 University Ave., Rochester 3, N. Y. Lees-Bradner Co., Cleveland, Ohio National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich. Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y. Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

GRINDING MACHINES, Internal

Aaron Machinery Co., Inc., 45 Crosby St., New
York 12, N. Y.

Arter Grinding Mch. Co., 15 Sagamore Rd.,
Worcester 5, Mass.

Bryant Chucking Grinder Co., Clinton St.,
Springfield, Vt.

Cosa Corp., 405 Lexington Ave., New York
17, N.

Frauenthal Div., Muskegon, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W.,
Grand Rapids 2, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

Standard Electrical Tool Co., 2488-90 River
Rd., Cincinnati, Ohio
Van Norman Mch. Co., Springfield, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig

Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich. Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile

GRINDING MACHINES, Profile
Baker Brothers, Inc., 1000 Post St., Toledo
10, Ohio
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York
17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, Surface Reciprocating

Reciprocating

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.,
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati 9, Ohio
Delta Power Tool Div., 400 Lexington Ave.,
Pittsburgh, Po.
DoAll Co., Des Plaines, III.
Elox Corp. of Mich., Royal Oak 3, Mich.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio
Gallmeyer & Livingston Co., 336 Straight Ave.,
S. W., Grand Rapids 4, Mich.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland
2, Ohio
Homestrand, Inc., Larchmont, N. Y.
Mattison Machine Works, Rockford, III.
Norton Co., 1 New Bond St., Worcester 6,
Mass.
Thompson Grinder Co., 1500 W. Main St.,
Springfield, Ohio
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Surface Rotary

Arter Grinding Mch. Co., 15 Sagamore Rd., Worcester 5, Mass. (Rotary)

(Continued on page 346)

CLEEREMAN

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A battery of box column and round column Cleereman Drilling Machines on production work. One of many such installations producing at lower costs with higher production, less operator fatigue and no down time.





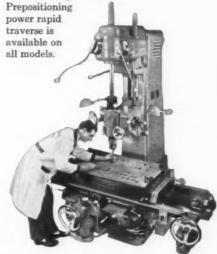
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LEVER OPERATED HYDRAULIC VALVES 5,000 psi. 2-way, 3-way and 4-way lions. Sizes 1/2" through 11/2".

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Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass. Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Mch. Co., Springfield, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich. Jones & Lamson Mch Co., Springfield, Vt. Landis Machine Co. (Centerless), Waynesboro, Pa. Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J. Sheffield Corp., Box 893, Dayton 1, Ohio

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GRINDING MACHINES, Universal

Aaron Machinery Co., Inc., 45 Crosby St., New
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati P, Ohio
Cosa Corp., 405 Lexington Ave., New York
17, N. Y.
Frauenthal Div., Muskegon, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W.,
Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Warcester 6,
Mass.
Oliver Instrument Co., 1410 E. Maumee St.,
Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Parker-Majestic, Inc., 147 Joseph Campau, Detroit, Mich.
Springfield Mch. Tool Co., 613 W. Southern
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Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave.,
Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6,
Mass. Norton Co., 1 New Bond St., Worcest Mass. Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Besly-Welles Corp. (Abrasive Div.), 20 N. Wacker Drive, Chicago 6, Ill.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Carborundum Co., Niagara Falls, N. Y.
Cincinnati Milling and Grinding Mchs., Inc.,
Cincinnati Milling Products Div., Cincinnati
9, Ohio
Centernati Milling Products Div., Cincinnati
9, Ohio
Delta Power Tool Div., 400 N. Lexington
Ave., Pittsburgh 8, Pa.
DoAll Co., 254 N. Laurel Ave., Des Plaines,
Ill. DoAll Co., 254 N. Laurel Ave., Des Praines, Ill. Gardner Machine Co., Beloit, Wis. Macklin Co., Jackson, Michigan Metal Carbides Corp., Youngstown, Ohio Norton Co., 1 New Bond St., Worcester 6, Mass. Simonds Abrasive Co., Tacony and Fraley St., Bridgesburg, Philadelphia, Pa.

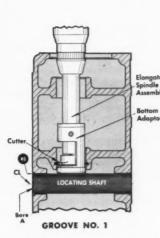
GROOVING TOOLS, Internal

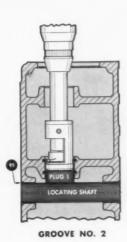
Scully-Jones & Co., 1906 So. Rockwell St., Chicago 8, III. Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

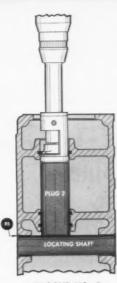
HAMMERS, Drop-See Forging

Waldes Truarc Grooving Tool pays for itself with big savings on one small run!

3 internal recesses cut in bores of 100 castings in 17.5 hours...including set-up time







GROOVE NO. 3

The job shown above called for three grooves located at prescribed distances from center-line CL of bore A. Depth and location tolerances: ±.0015".

Size and shape of the castings made nesting difficult for a boring bar operation. Exterior surfaces were unmachined, making alignment complicated. With two grooves over 7" from the housing's open end, boring bar chatter could have caused costly rejects.

To overcome these obstacles a Waldes Truarc Grooving Tool was equipped with an elongated spindle assembly and bottom adaptor. The tool was mounted in a drill press, the castings in a large vise. Grooves were then cut as follows:

Groove No. 1: A locating shaft was inserted into bore A as a reference surface and the tool piloted into the housing until the bottom adaptor banked on the shaft. The tool is designed so that the cutter rotates in

a neutral position until additional downward pressure is applied. It then moves into cutting position until preset groove depth is reached, after which the tool idles. Release of pressure returns the cutter to neutral so that the tool may be withdrawn.

Groove No. 2: Plug 1 was inserted into the bore over the locating shaft and the tool again piloted into the bore. The groove was then cut the same way as Groove No. 1.

Groove No. 3: Plug 2 was substituted for the first plug and the cutting operation repeated.

All 300 grooves were held to prescribed tolerances. Set-up time: exactly 11 minutes. Operating time: 1050 minutes for 100 castings. Rejects: none!

No recessing problem is too tough for the amazingly versatile Waldes Truarc Grooving Tool. It's so simple even unskilled labor can use it accurately.

Write for a 20-page manual containing full information on Waldes Truarc Grooving Tool.



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TRUARC

GROOVING TOOL

U.S. Pat. 2,411,426.

WALDES KOHINOOR, INC., 47-16 Austel Place, L.I.C. 1, N.Y.



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HAMMERS, Power

Chambersburg Engrg, Co., Chambersburg, Pa Edlund Mchry, Co. Div., Cortland, N. Y. Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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General Electric Co., Schenectady, N. Y. Holcroft & Co., 6545 Epworth Blvd., Detroit 10, Mich.

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Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y. Wilson Mechanical Instrument Co., Inc., 230-D Park Ave., New York, N. Y.

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HOBS

Barber-Colman Co., Rock and Montague, Rock-ford, III.
Goddard & Goddard Co., Detroit, Mich.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co., Rochester, Mich. National Iwisi Pili Mich. Russell, Holbrook & Henderson, Inc., 292 Madi-son Ave., New York 17, N. Y. Star Cutter Co., 34500 Grand River, Farm-ington, Mich.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y. Thor Power Tool Co., Aurora, Illinois

HOISTS, Electric

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, III.
Micromatic Hone Corp., 8100 Schoolcraft,
Detroit 4, Mich.
Moline Tool Co., 102-20th St., Moline, III.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

HONING STONES

Barnes Drill Co., 814 Chestnut St., Rockford, Norton Co., 1 New Bond St., Worcester 6, Mass.

American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y. Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

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Tools and equipment Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa. Barnes Drill Co., 814 Chestnut St., Rockford, III. Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsbero,
Pa.

348-MACHINERY, July, 1957

Bliss, E. W., Co., 1375 Raff Rd., S. W., Canton, Ohio Engrg. Co., Chambersburg, Pa. Colonial Broach & Machine Co., P.O. Box 37, Harper Sta., Detroit 13, Mich. Cross Co., 3250 Bellevue Ave., Detroit 7, Mich. Denison Engrg. Co., 1160 Dublin St., Columbus 16, Ohio Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio Erie Foundry Co., Erie, Pa. Hansion-Whitney Co., 169 Bartholomew Ave., Ill. III.

Hanson-Whitney Co., 169 Bartholomew Ave.,
Hartford 3, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Dhio
Loke Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.

Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave.,
Detroit 4, Mich.

Motch & Merryweather Machinery Co., Penton
Bldg., Cleveland, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee,
Wis.

Rockford Mch. Tool Co., 2500 Kishwaukee St. Wiss.

Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.

Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

Verson Alisteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich. Watson-Stillman Co., Roselle, N. J.

Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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Barnes, W. F. & John Co., 201 S. Waterford
St., Rockford, III.
Elmes Eng. Div., American Steel Foundries,
1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
32, Mich.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines,
III.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines,
III.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, III.

Artford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio

Le Maire Tool & Mfg. Co., Dearborn, Mich.

Michigan Drill Head Co., Detroit 34, Mich.

Oilgear Co., 1569 W. Pierce St., Milwaukee,

Wiskers Incorporated Diversion Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St.,
Newark, N. J.
Etco Tool Co., Inc., 594 Johnson Ave., BrookIyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmirg, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.,
Kearney & Trecker Corp., 6784 W. National,
Milwaukee 14, Wis.
Morris, Robert E. Co., 76 Mamaroneck Ave.,
White Plains, N. Y.
Opto-Metric Tools, Inc., 137 Varick St., New
York, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd.,
Detroit 39, Mich.
Sundstrand Mch. Teol Co., 2531 11th St., Rockford, Ill.
Van Norman Mch., 3640 Main St., Springfield 7, Mass.
Wadell Equip. Co., Clark, N. J.
Western Machine Tool Works, Holland, Mich.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. 1. DoAli Co., Des Plaines, III. duMont Corp., 289 Wells St., Greenfield, Mass. Starrett, L. S., Co., Athol, Mass.

INDICATOR LIGHTS-See Lights, Indicator

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass. Brown & Sharpe Mfg. Co., Providence, R. I. DoAll Co., 254 N. Laurel Ave., Des Plaines, III.
Federal Products Corp., P. O. Box 1027, Providence, R. I.
Lurkin Rule Co., Saginaw, Mich.
National Automatic Tool Co., S. 7th-N. Sts.,
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Ingersoll-11 Broadway, New York 4, N.Y. Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J. Starrett, The L. S. Co., Athol, Mass.

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INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I., Federal Products Corp., P. O. Box 1027, Provi-dence, R. I. National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.

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INSPECTION EQUIPMENT, Ultrasonic Curtiss-Wright Corp., Caldwell, N. J.

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Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.

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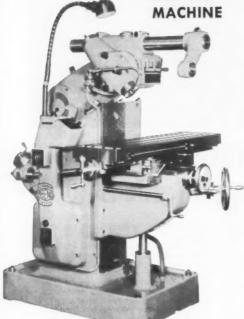
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Size Control Co., Div. of American Gage & Mch. Co., 2500 W. Washington Blvd., Chicago 12, III.

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Gisholt Machine Co., 1245 E. Washington Ave.,
Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and
Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy.,
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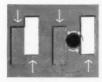
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Homestrand, Inc., Larchmont, N. Y.
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Levin, Louis & Son, Los Angeles 21, Colif.
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LATHES, Crankshaft

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Angeles 58, Calif.
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Div., Hamilton, Oilo
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohlo
Monarch Machine Tool Co., 27 Oak St., Sidney,
Ohlo
Sidney Machine Tool Co., Sidney, Ohlo
Triplex Machine Tool Corp., 75 West St., New
York 6, N. Y.

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LATHES, Engine, Manufacturing
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Angeles 58, Calf.
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Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York
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Delta Power Tool Div., Rockwell Mfg. Co.,
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Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and
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Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
(Continued on page 354)

(Continued on page 354)

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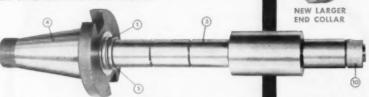
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LATHES, Engine, Toolroom

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Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
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Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
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LATHES, Gap

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(Continued on page 356)



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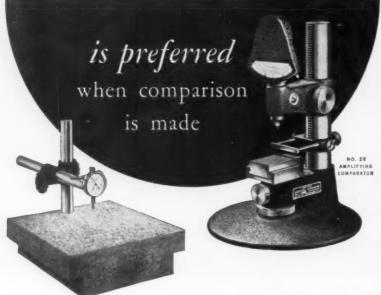
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MACHINERY, July, 1957-355



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Jones & Lamson Mch. Co., 512 Clinton St.,
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Delta Power Tool Div., Rockwell Mfg. Co.,
Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave.,
Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave.,
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Jones & Lamson Mch. Co., 512 Clinton St.,
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New Britain Mch. Co., New Britain-Gridley Div., York 3, N. Y.
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Seneca Falls, Mch. Co., Seneca Falls, N. Y.
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- 3 Shearing can be combined with stamping of simple shapes
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Van Keuren Co., Watertown 72, Mass.
Williams, J. H., & Co., 400 Vulcan St., Buffalo
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MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES

Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich. Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MATERIAL-HANDLING TRUCKS-See Trucks, Material Handling

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MEASURING WIRES, Thread, Spline, Gear

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Tool Co., Fond du Lac, Wis.

Gorton, George, Mch. Co., 1110 W. 13th St.,
Racine, Wis.

Greaves Mch. Tool Div., 2011 Eastern Ave.,
Cincinnati 2, Ohio

Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.

Homestrand, Inc., Larchmont, N. Y.

Kearney & Trecker Corp., Milwaukee, Wis.

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Van Noman Co., 3640 Main St., Springfield
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Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich. Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampère, N. J. Consolidated Machine Tool Corp., Rochester,

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Simplex, Duplex
Brown & Sharpe Mfg, Co., 235 Promenade St.,
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Cincinnotri Milling & Grinding Mches., Inc.,
470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road,
Rochester 10, N. 1.
Espen-Lucas Mch. Wrks, Front St. and Girard
Ave., Philadelphia, Pa.
Ingersoll Milling Mch. Co., 2442 Douglas St.,
Rockford, Ill.,
Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New
York 3, N. Y.
Morris, Robert E. Co., 76 Mamaroneck Ave.,
White Plains, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St.,
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Colonial-Romulus Div., Parkgrove Station, Detroit 5, Mich.
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(Continued on page 362) America's Most Complete Line of Self-Protected Bearings



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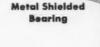
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Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.

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Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.

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Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.

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Van Norman Co., 3640 Main St., Springfield 7, Mass. MILLING MACHINES, Knee Type Rise

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Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis., Larchmont, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis., Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
South Bend Lathe Wks., South Bend 22, Ind.

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Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio (Continued on page 364)

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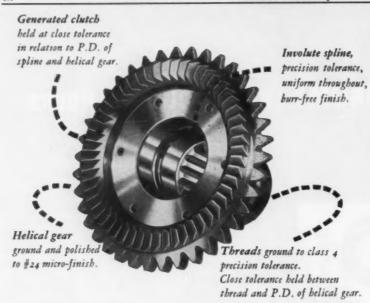
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PRECISION MACHINES

DETROIT 7, MICHIGAN



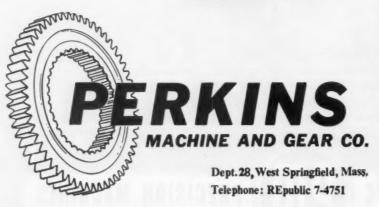
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Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.,
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.

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MILLING MACHINES, spor

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Div., Hamilton, Ohio
Cincinnati Milling & Grinding Mches., Inc.,
4701 Marburg Ave., Cincinnati 9, Ohio
G & L and Hypro Div., Giddings & Lewis Mch.
Tool Co., Fond du Lac, Vis.
Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New
York 3, N. Y. Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, III.

MILLING MACHINES, Thread

Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.

MOLDING MACHINES, Plastic

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MOTORS, Electric
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Delta Power Tool Div., Rockwell Mfg. Co.,
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General Electric Co., Schenectady, N. Y.
Howell Electric Motors Co., Howell, Mich.
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Reliance Electric & Engrg. Co., 1074 Ivanhoe
Rd., Cleveland 10, Ohio

MOTORS, Hydraulic

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MULTIPLE INSPECTION GAGES-See Gages, Multiple Inspection

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Baker Bros., Inc., 1000 Post St., Toledo 10, Ohio
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Baush Mch. Tool Co., 15 Wason Ave., Spring-field, Mass.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave.,
Brooklyn 37, N. Y.
Federal Prod. Corp., 1144 Eddy St., Providence
1, R. I.
Greenlee Bros. & Co., 2136 - 12th St., Rock-ford, Ill.
Hartford Special Machinery Co., 287 Home-1, R. I.
Greenlee Bros. & Co., 2136 - 12th 51.,
ford, III.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
LoSalle Tool, Inc., 3840 E. Outer Drive, Detroit
34, Mich.
Modern Industrial Engrg. Co., 14230 Birwood
Ave., Detroit 38, Mich.
(Continued on page 366)



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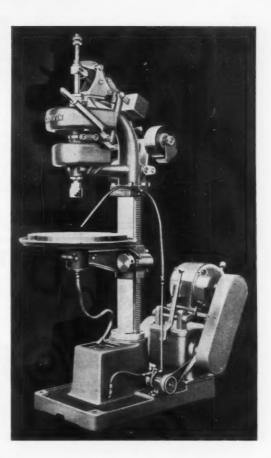
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Baker Bros., Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, III.
Baush Mch. Tool Co., 15 Watson Ave., Spring-field, Mass.

Buhr Mch. Tool Co., 839 Green St., Ann Arbor,

Bullard Co., Bridgeport 6, Cohn.
Cincinnati Milling Mch. Co., Cincinnati 9,
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Ohio
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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
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Greenlee Bros. & Co., 2136 - 12th St., Rock-ford, Ill.

ford, III.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., Milwaukee, Wis.
Le Maire Tool & Mfg. Co., Dearborn, Mich.

Modern Industrial Engrg. Co., 14230 Birwood Ave., Detroit 38, Mich.

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PRESS BRAKES-See Brakes, Presses and Bending

PRESS FEEDERS, Automatic

Bliss Co., E. W., Canton, Ohio Federal Press Co., 511 Division St., Elkhart, Federal Press Co., 311 United Ind.
Ind.
Nilson, A. H. Machine Co., Bridgeport, Conn.
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Bridgeport 1, Conn.
U. S. Tool Co., East Orange, N. J.

PRESSES, Arbor

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. du Mont Corp., Greenfield, Mass. Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio Hannifin Corp., 510 S. Wolf Rd., Des Plaines, III. III.
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St.,
Greenfield, Mass.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Assembling

Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio Ohio
Colonial Broach & Machine Co., Box 37, Detroit 13, Mich.
Detroit Broach Co., Inc., 950 S. Rochester Rd.,
Rochester, Mich.
Elmes Eng. Div., American Steel Foundries,
1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Press Co., 511 Division St., Elkhart,
Ind. Ferracute Machine Co., Bridgeton, N. J. Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Hitalic Press Mfg. Co., Mount Gilead, Ohio Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Blanking, Stamping

Alpha Press & Machine, Inc., 9281 Freeland Ave., Detroit 28, Mich. Baird Machine Co., 1700 Stratford Ave., Strat-ford, Conn. Bath, Cyril Co., 32324 Solon Rd., Solon, Ohio Birdsoro Steel Foundry & Machine Co., Birdsboro, Pa. Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Chambersburg Engineering Co., Chambersburg, Pa: Parting Machine Corp., 6499 W. 65th St., Chicago 38, III.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St.
Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 S.
Laramie, Chicago 50, III.
Federal Machine & Welder Co., 1745 Overland
Ave. N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart Ind. Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkartind.
Ind.
Lake Tie Machinery Corp., 470 Woodward
Ave., Buffalo 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio

Minster Machine Co., Minster, Ohio Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y. U. S. Tool Co., Inc., 255 N. 18th St., East Orange, N. J. V & O Press Co., Hudson, New York Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, III. Wilson, K. R., Inc., Arcade, N. Y.

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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Clincinnati 29, Ohio Hydraulic Press Mfg. Co., Mount Gilead, Ohio Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y. Wilson, K. R., Inc., Arcade, N. Y.

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Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton,
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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward
Ave., Buffalo 17, N. Y.
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Federal Machine & Welder Co., 1745 Overland
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Feracute Machine Co., Bridgeton, N. J.
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Lake Erie Machinery Corp., 470 Woodward
Ave., Buffolo 17, N. Y.
Minster Machine Co., Minster, Ohio Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y. Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill. Wilson, K. R., Arcade, N. Y. Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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PRESSES, Die Tryout

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Warren, Ohio
Federal Press Co., 511 Division St., Elkhart,
Ind. Ferracute Machine Co., Bridgeton, N. J. Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Hannifin Corp., 510 S. Wolf Rd., Des Plaines, III.
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Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
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Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Cons.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, III.
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PRESSES, Drawing

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Cincinnati Milling & Grinding Machines, Inc.,
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Clearing Machine Corp., 6499 W. 65th St.,
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Lake Erle Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y. Misser Machine Co., Minster, Ohio Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
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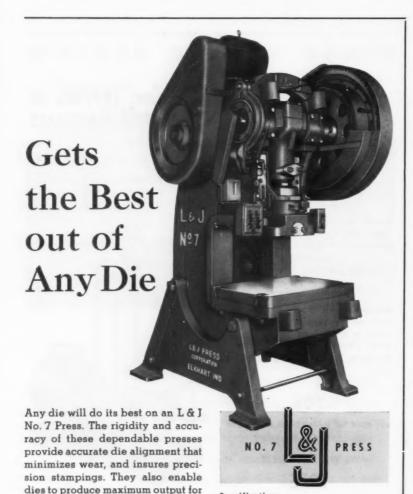
PRESSES, Foot

Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland
Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave.,
Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood
Ave., Chicago 19, III.
Wilson, K. R., Arcade, N. Y.

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(Continued on page 370)



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Lake Erie Machinery Corp., 470 Woodward
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Minster Machine & Tool Wks., 637 Northland
Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood
Ave. Chicago 19, 111
Wood, R. D. Co., 1072 Public Ledger Bldg.,
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Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, III.
Wales-Strippit Corp., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

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Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Centon, Ohio
Clearing Machine Corp., 6499 W. 65th St.,
Chicago 38, III.
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Cleveland Punch & Shear Wks. Co., 3917 St.
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Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, III.
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Blvd., Chicago 36, III.
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Federal Press Co., 511 Division St., Elkhart, Ind.
Ferracute Machine & Welder Co., 1745 Overland
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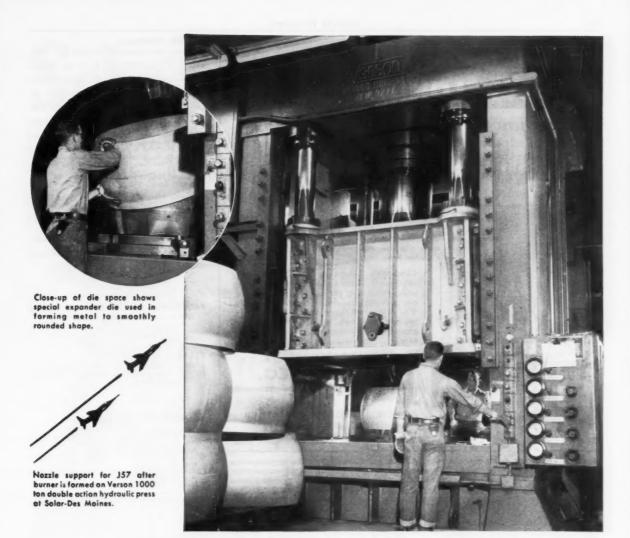
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PRESSES, Quenching

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Lake Erie Machinery Corp., 470 Woodward
Ave., Buffalo 17, N. Y.
Niogara Machine & Tool Wks., 637 Northland
Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood
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Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Alisteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
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PROFILING MACHINES-See Milling Machine, Die Sinking, etc.

PULLEYS

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16, Ohio
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Viking Pump Co., Cedar Falls, Iowa
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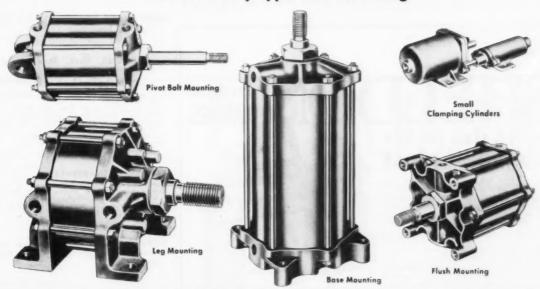
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Espen-Lucas Mach. Works, Philadelphia, Pa.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Starretf, The L. S. Co., Athol, Mass.
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(Continued on page 378)

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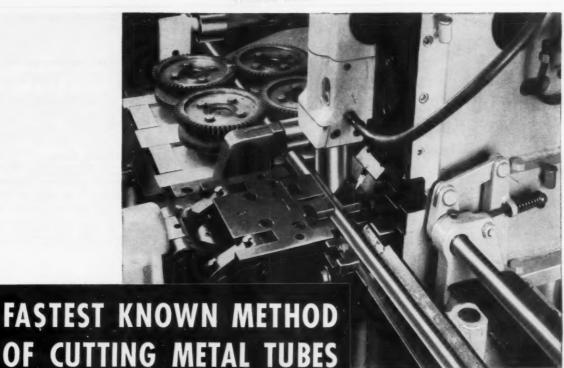
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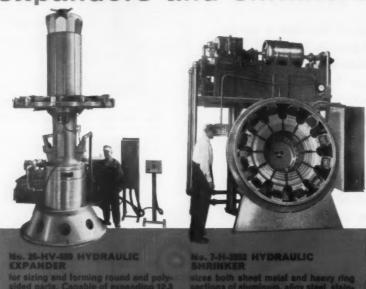


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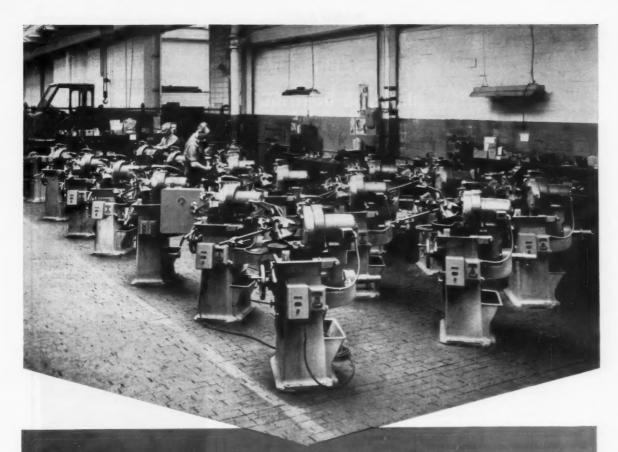
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(Continued on page 382) (Continued on page 382)



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Ettco Tool Co., Inc., 592 Johnson Ave., Brooklyn, N. Y.
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Ohio
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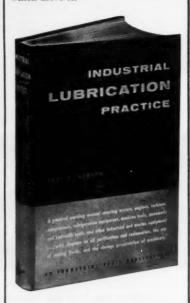
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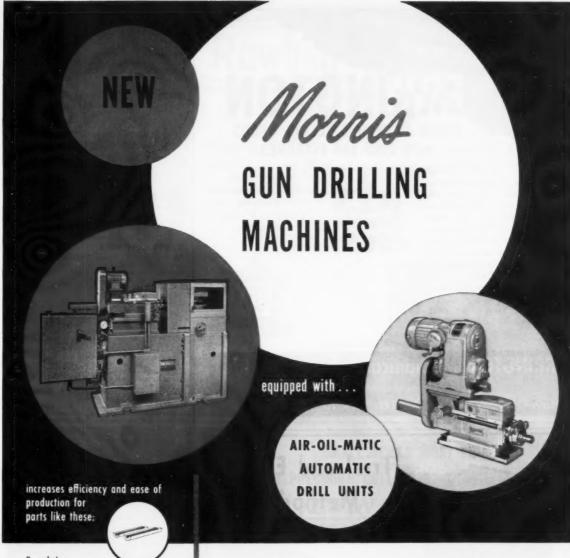
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(Continued on page 386)

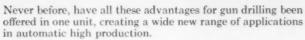




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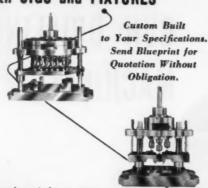




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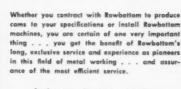




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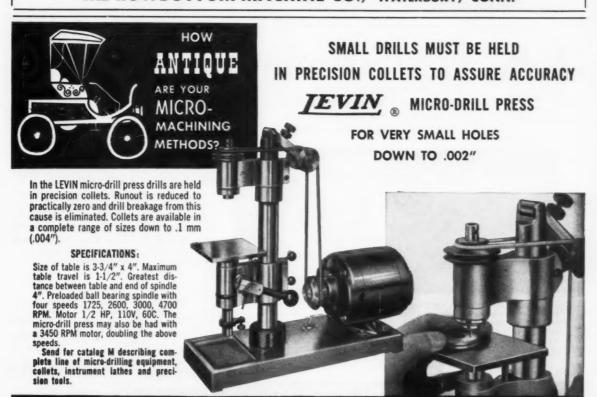
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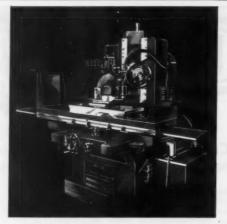
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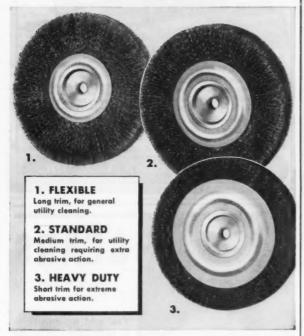
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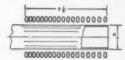




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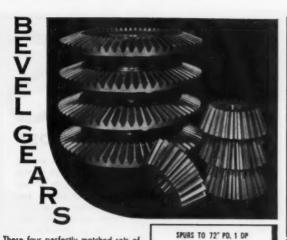
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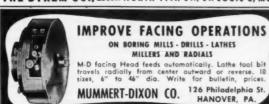
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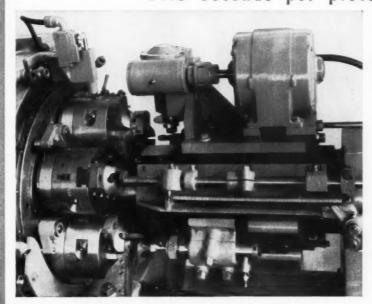
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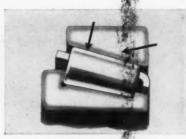
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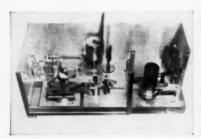
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